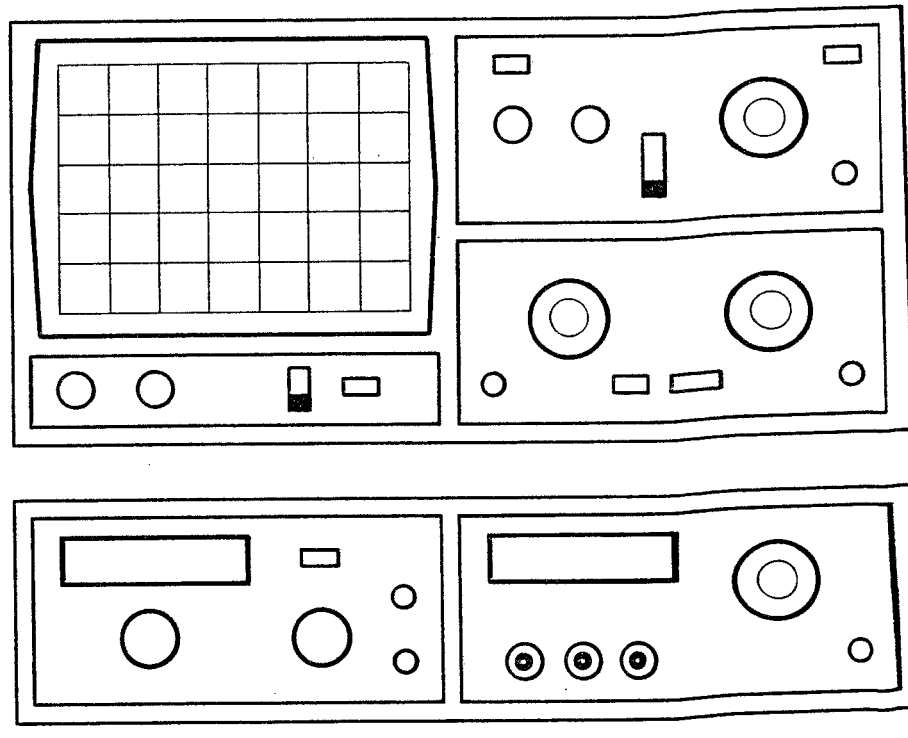
HAMEG
Instruments

MANUAL



Service Manual
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Adjustment Procedure

HM604-3

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KONFORMITÄTSERKLÄRUNG
DECLARATION OF CONFORMITY
DECLARATION DE CONFORMITE

CE

HAMEG®
Instruments

Name und Adresse des Herstellers
Manufacturer's name and address
Nom et adresse du fabricant

HAMEG GmbH
Kelsterbacherstraße 15-19
D - 60528 Frankfurt

HAMEG S.a.r.l.
5, av de la République
F - 94800 Villejuif

Die HAMEG GmbH / HAMEG S.a.r.l bescheinigt die Konformität für das Produkt
The HAMEG GmbH / HAMEG S.a.r.l herewith declares conformity of the product
HAMEG GmbH / HAMEG S.a.r.l déclare la conformite du produit

Bezeichnung / Product name / Designation: Oszilloskop/Oscilloscope/Oscilloscope

Typ / Type / Type: **HM604-3**

mit / with / avec: -

Optionen / Options / Options: -

mit den folgenden Bestimmungen / with applicable regulations / avec les directives suivantes

EMV Richtlinie 89/336/EWG ergänzt durch 91/263/EWG, 92/31/EWG
EMC Directive 89/336/EEC amended by 91/263/EWG, 92/31/EEC
Directive EMC 89/336/CEE amendée par 91/263/EWG, 92/31/CEE

Niederspannungsrichtlinie 73/23/EWG ergänzt durch 93/68/EWG
Low-Voltage Equipment Directive 73/23/EEC amended by 93/68/EEC
Directive des equipements basse tension 73/23/CEE amendée par 93/68/CEE

Angewendete harmonisierte Normen / Harmonized standards applied / Normes harmonisées utilisées

Sicherheit / Safety / Sécurité

EN 61010-1: 1993 / IEC (CEI) 1010-1: 1990 A 1: 1992 / VDE 0411: 1994
Überspannungskategorie / Overvoltage category / Catégorie de surtension: II
Verschmutzungsgrad / Degree of pollution / Degré de pollution: 2

Elektromagnetische Verträglichkeit / Electromagnetic compatibility / Compatibilité électromagnétique

EN 50082-2: 1995 / VDE 0839 T82-2
ENV 50140: 1993 / IEC (CEI) 1004-4-3: 1995 / VDE 0847 T3
ENV 50141: 1993 / IEC (CEI) 1000-4-6 / VDE 0843 / 6
EN 61000-4-2: 1995 / IEC (CEI) 1000-4-2: 1995 / VDE 0847 T4-2: Prüfschärfe / Level / Niveau = 2

EN 61000-4-4: 1995 / IEC (CEI) 1000-4-4: 1995 / VDE 0847 T4-4: Prüfschärfe / Level / Niveau = 3

EN 50081-1: 1992 / EN 55011: 1991 / CISPR11: 1991 / VDE0875 T11: 1992
Gruppe / group / groupe = 1, Klasse / Class / Classe = B

Datum /Date /Date
14.12.1995

Unterschrift / Signature /Signatur

Dr. J. Herzog
Technical Manager
Directeur Technique

Specifications

Vertical Deflection

Operating modes: Channel I or II separate, Channel I and II: alternate or chopped. (0.5MHz chopper frequency, approx.)
Sum or **difference** with Ch. I and Ch. II (both channels invertable).
XY-Mode: via channel I and channel II
Frequency range: 2xDC to 60MHz (-3dB)
Risetime: <5.9ns. Overshoot max. 1%.
Deflection coefficients: 14 calibrated steps from **1mV/div.** to **20V/div.** (1-2-5 sequence) with variable 2.5:1 up to **50V/div.**
Accuracy in calibrated position:
1mV/div. to 2mV/div.: ±5% (0 to 10MHz (-3dB))
5mV/div. to 20V/div.: ±3%
Input impedance: 1MΩ II 20pF.
Input coupling: DC-AC-GD (ground).
Input voltage: max. 400V (DC + peak AC).
Delay line: approx. 90ns

Triggering

Automatic: (peak to peak) **<20Hz-100MHz** (≤ 0.5div.)
Normal with level control: **DC-100MHz** (≤0.5div.)
Slope: positive or negative,
ALT. Triggering; LED indicator for trigger action
Sources: Channel I or II, CH. I alternating CH II, line and external
Coupling: **AC** (10Hz to 100MHz), **DC** (0 to 100MHz), **HF** (1.5kHz to100MHz), **LF** (0 to 1.5kHz)
Active TV-Sync-Separator (pos. and neg.)
External: ≥0.3V_{pp} from DC to 60MHz
2nd triggering (Del. Trig.): normal with level control DC to 100 MHz

Horizontal Deflection

Time coefficients: 22 calibrated steps from 0.5s/div. to 50ns/div. in 1-2-5 sequence
Accuracy in calibrated position: ±3%.
variable 2.5:1 up to 1.25s/div.,
with X-Mag. x10: 5ns/div. ±5%
Holdoff time: variable to approx. 10:1
Delay: 50ms - 100ns, variable 6:1 up to 300ms
Bandwidth X-amplifier: 0-3MHz (-3dB).
Input X-Amplifier via Channel II,
(sensitivity see Channel II specification)
X-Y phase shift: <3° below 120kHz.

Operation / Control

Auto Set (automatic parameter selection)
Manual (Front Panel switches)
Memory for 6 user-defined parameter settings
Remote control with built-in RS-232 interface

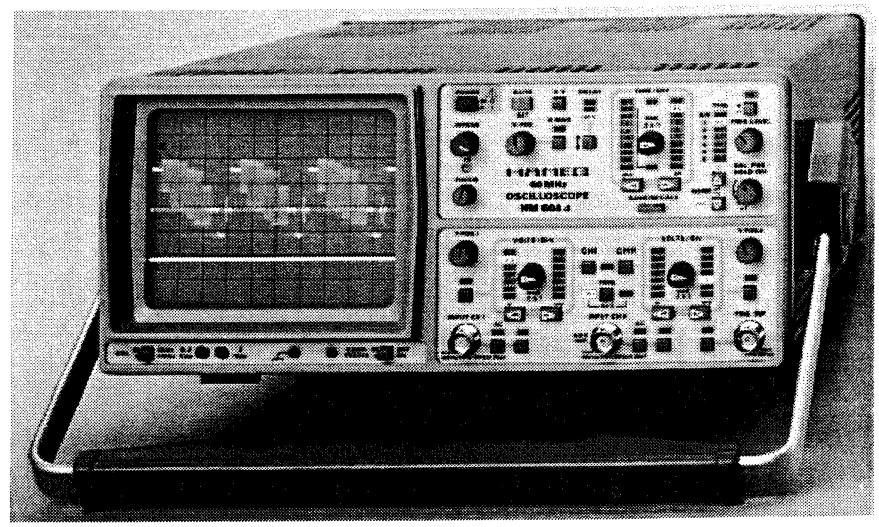
Component Tester

Test voltage: approx. 8.5V_{rms} (open circuit).
Test current: approx. 7mA_{rms} (shorted).
Test frequency: approx. 50Hz
Test connection: 2 banana jacks 4mmØ
One test lead is grounded (Safety Earth)

General Information

CRT: D14-372GH, rectangular screen (8x10div.) internal graticule
Acceleration voltage: approx 14kV
Trace rotation: adjustable on front panel
Calibrator: square-wave generator (t_r <4ns) ≈1kHz/1MHz; Output: 0.2V ±1% and 2V
Line voltage: 100-240V AC ±10%, 50/60Hz
Power consumption: approx. 40 Watt at 50Hz.
Min./Max. ambient temperature: -10°C...+40°C
Protective system: Safety class I (IEC1010-1)
Weight: approx. 5.6kg (12.4lbs), color: techno-brown
Cabinet: W 285, H 125, D 380 mm (11.1x4.9x14.8 inches)
Lockable tilt handle

Subject to change without notice. 10/95



60MHz Multi-Function Oscilloscope HM 604-3

with Auto-Set, Save and Recall (6 Setup Memories) Remote control via built-in RS-232 Interface

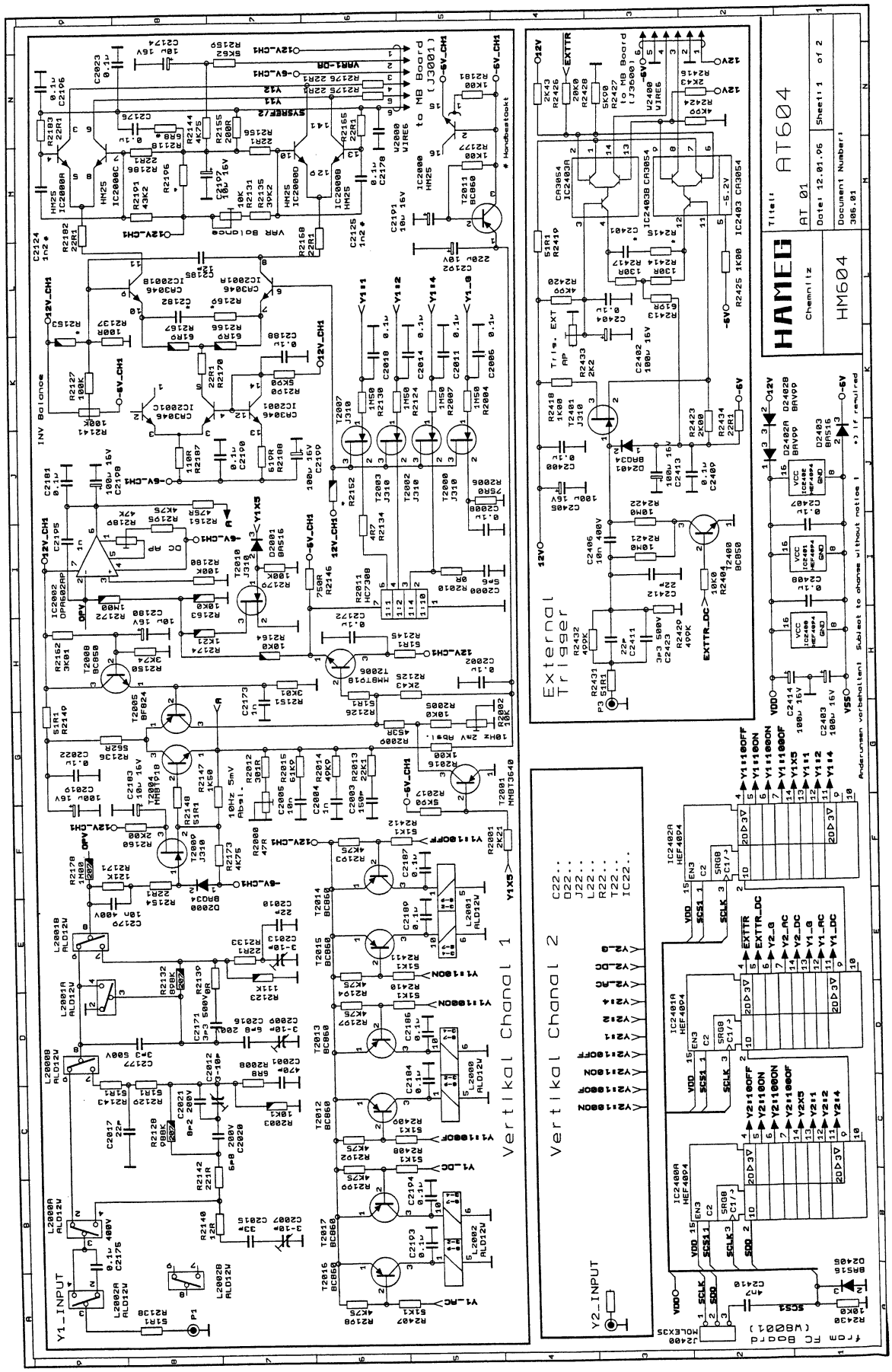
Vertical: 2 Channels, 1 mV/div. - 20 V/div., Comp.-Tester, 1MHz Calibrator

Time Base: 0.5 s/div. to 5 ns/div.; Trigger-after-delay; Alternate Trigger

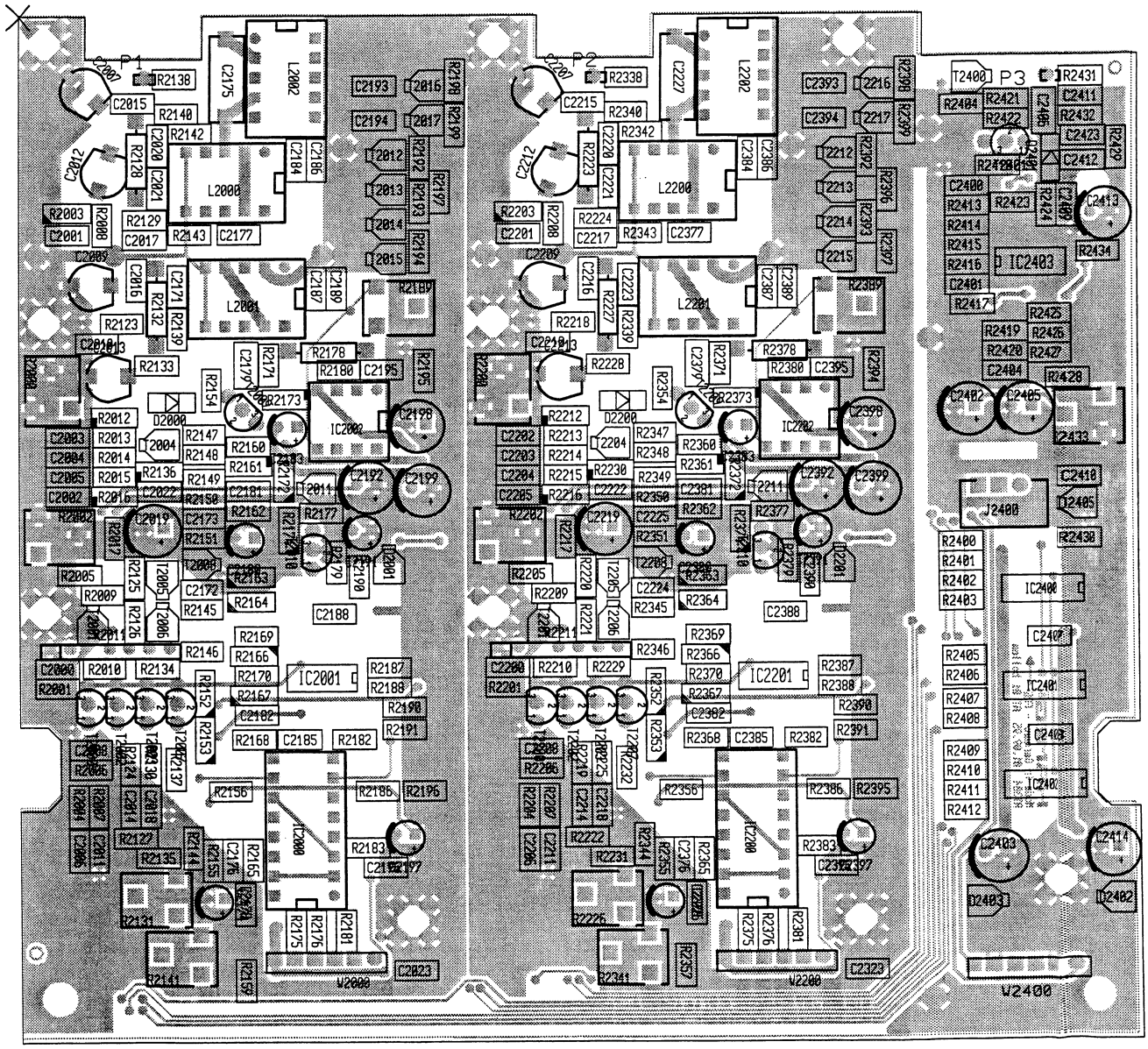
Triggering: DC to 100 MHz; Automatic Peak to Peak; TV-Sync-Separator

The **HM604-3** is **HAMEG's 60 MHz** microprocessor controlled analog oscilloscope. The internal **microprocessor** has the capability of automatically configuring the oscilloscope parameters, when used in the **"Auto Set"** mode, so as to present a display of three cycles of the input signal, with all of the proper control settings **automatically configured**: a single trace will be displayed with 4 to 6 divisions amplitude, while each signal will be 3 to 4 divisions high in dual trace mode. At a touch of the controls, the user can over-ride the automatic settings. Manual control is simple with easy to see indicators denoting uncalibrated operation by blinking. Switch/parameter settings are easily visible as bright **LED scale** value indications.
One powerful feature is the ability to store user-defined test scenarios, that can be called up on demand for repeated measurement tasks. A total of **6 setups** can be **saved** and **recalled** as many times as required. Additional setup information is possible via the **RS-232** port, which can be controlled from the serial port of a PC.
Although the instrument's vertical bandwidth is specified as **60 MHz**, signals to **100 MHz** can be **displayed** and **triggered**. Signal expansion up to a factor of 1,000 times can be obtained in the **"Delay"** and **"Trigger after Delay"** modes. A switching mode power supply minimises power and results in a lightweight unit weighing only 12.4 pounds (5.6kg).
The scope is ideal for fast troubleshooting. The Auto Set feature permits the rapid inspection of test points, without the need to constantly adjust the scope for each new test mode. The ability to Save/Recall facilitates the use of this unit for final inspections, where multiple, repeated scope settings are required. These capabilities result in labor saving operations which translate to more efficiency and cost savings to the customer.

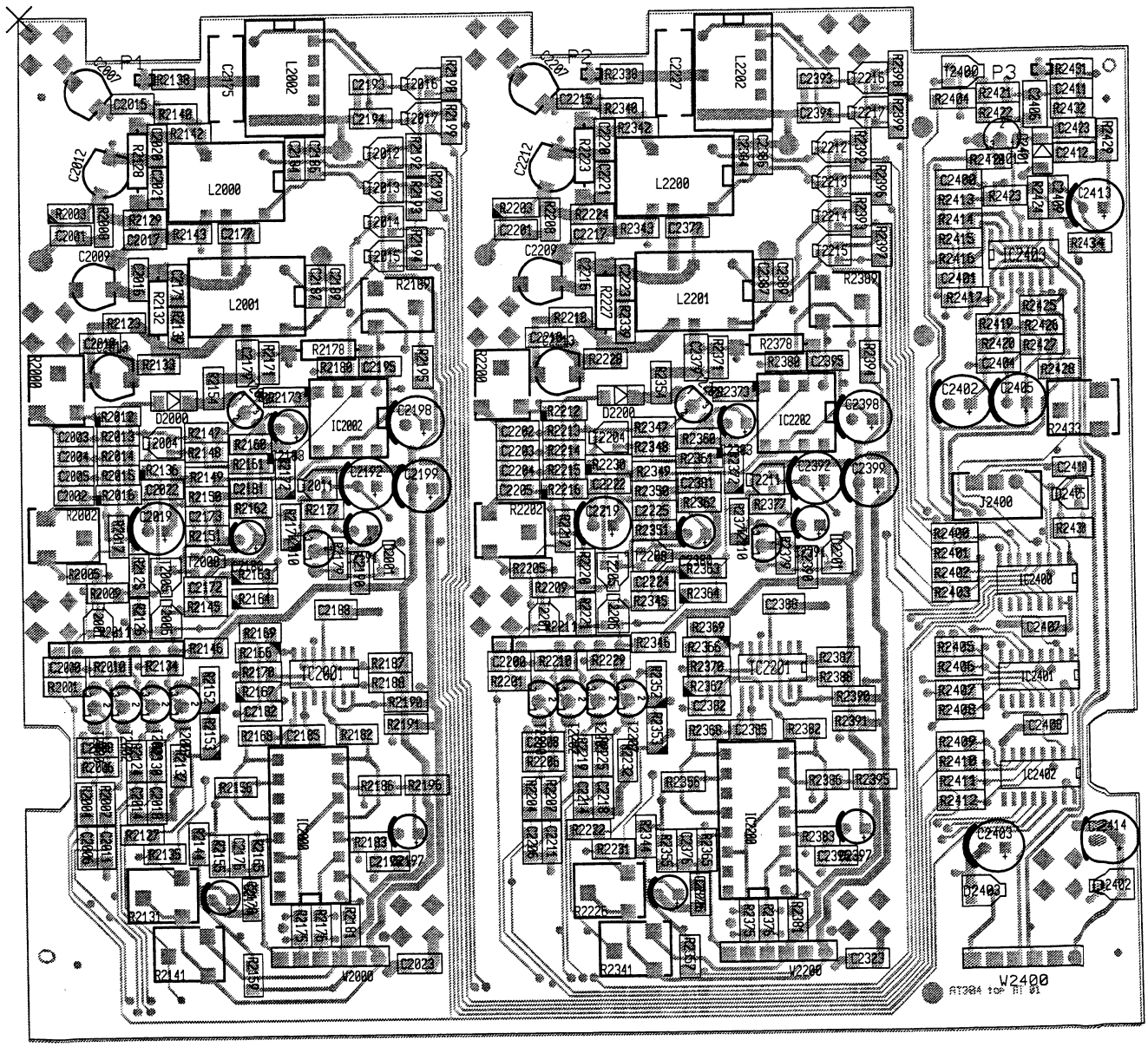
Accessories supplied: Line Cord, Operators Manual, 2 Probes 10:1



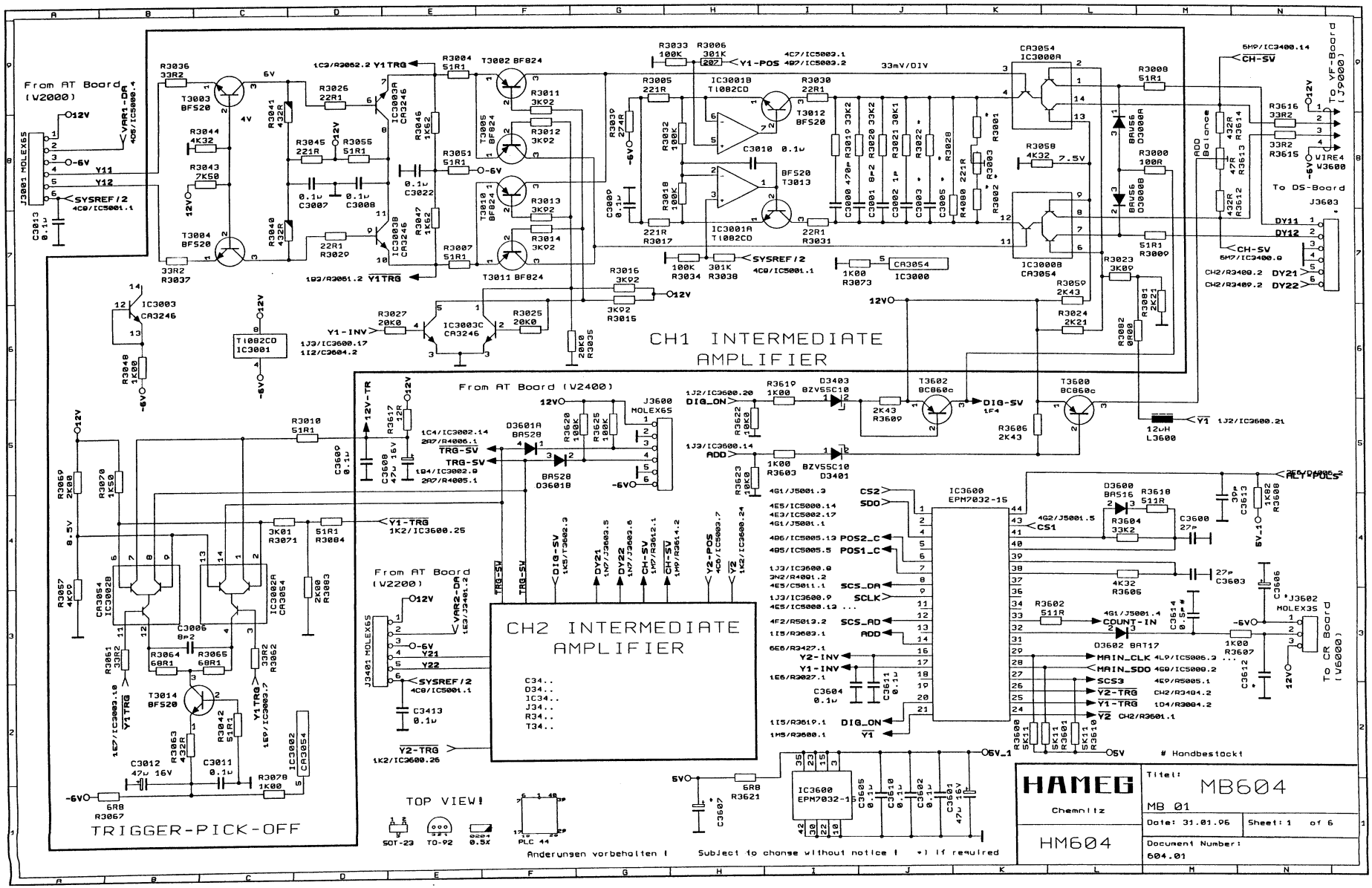
Subject to change without notice

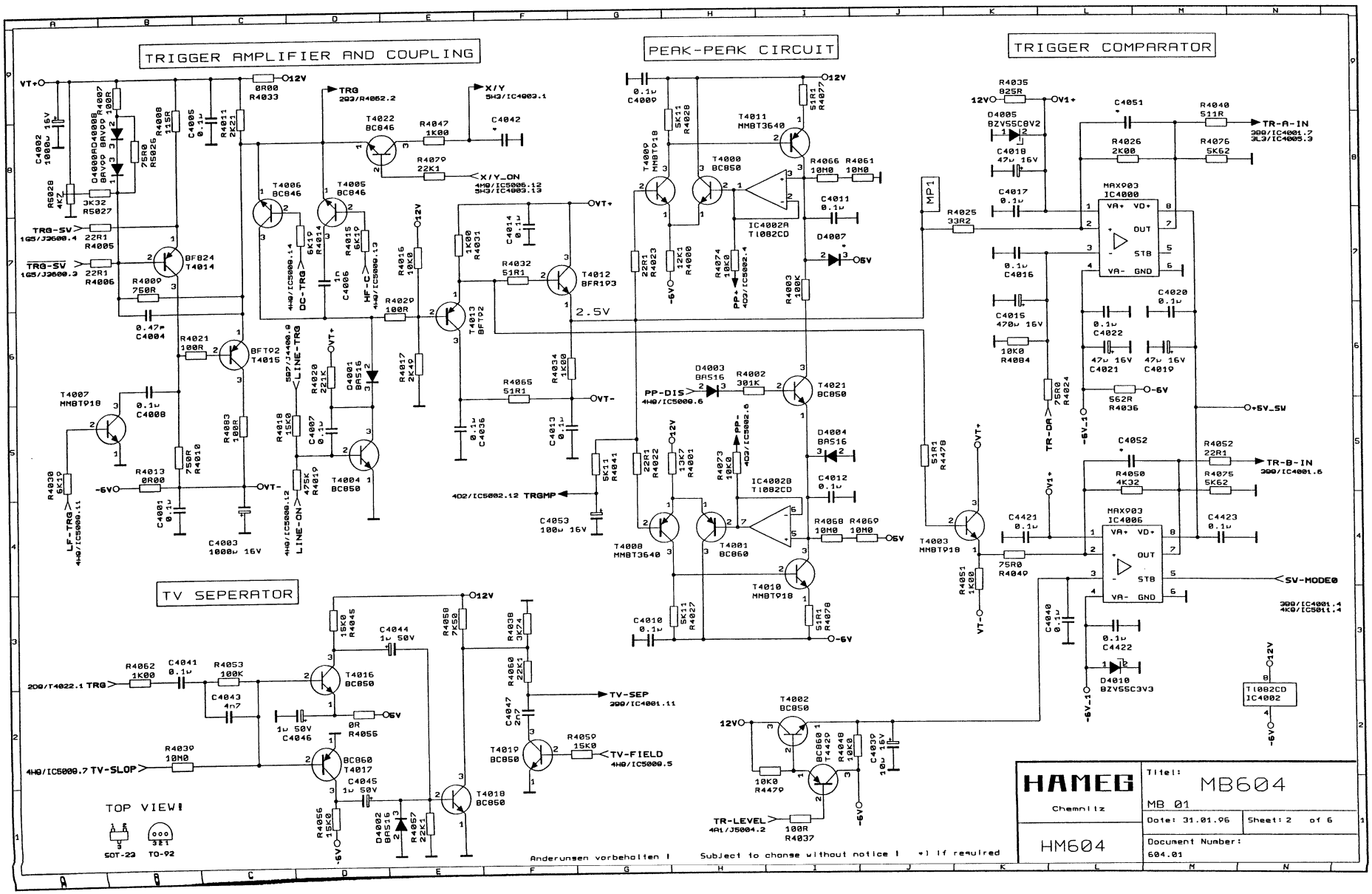

P1
P2
P3
L2000
L2001
L2002
L2200
L2201
L2202
IC2001
IC2002
IC2201
IC2202
IC2400
IC2401
IC2402
IC2403
D2000
D2200
J2400
T2400
W2000
W2200
W2400

AT-Board (Bottomside)

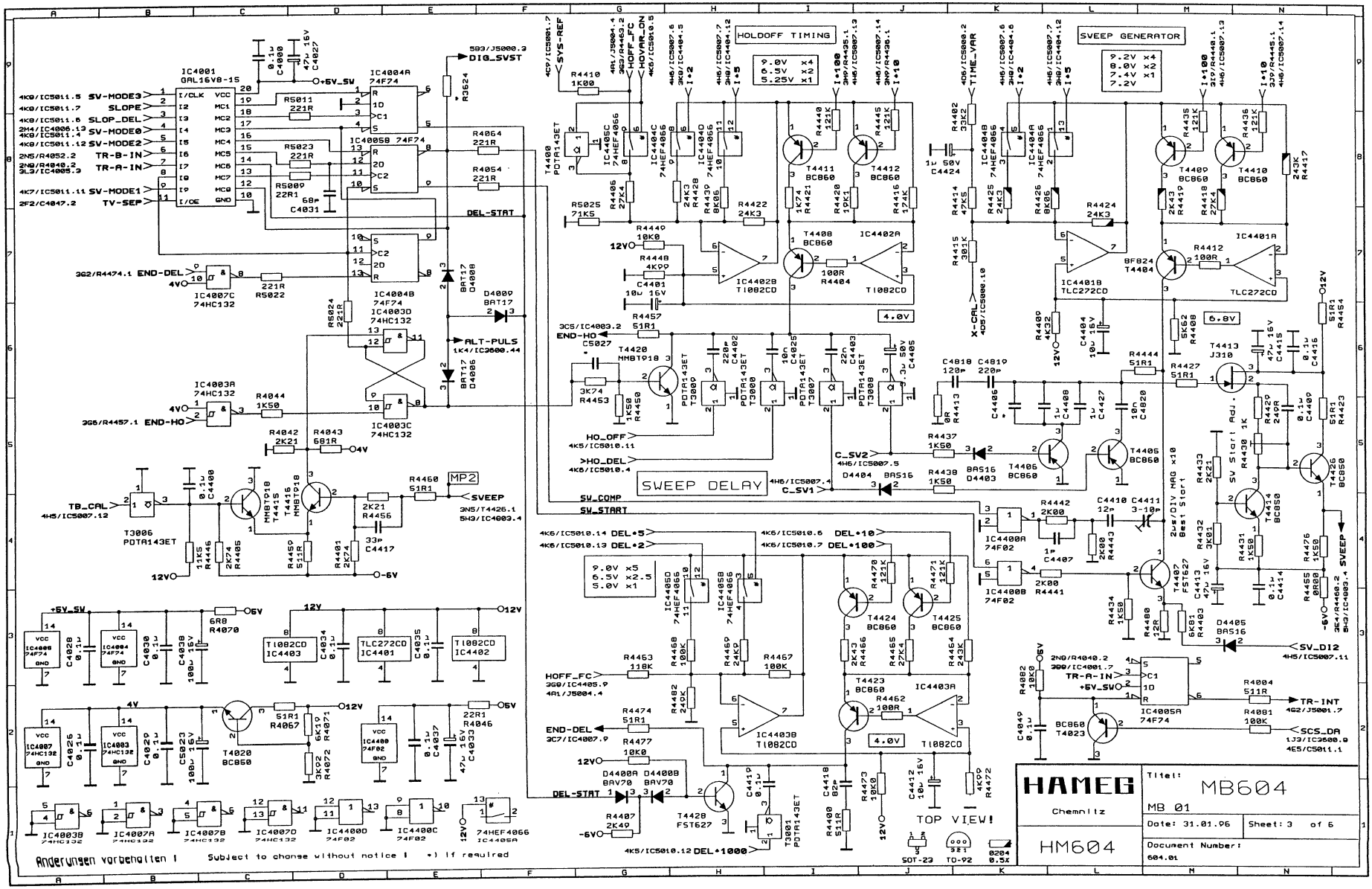


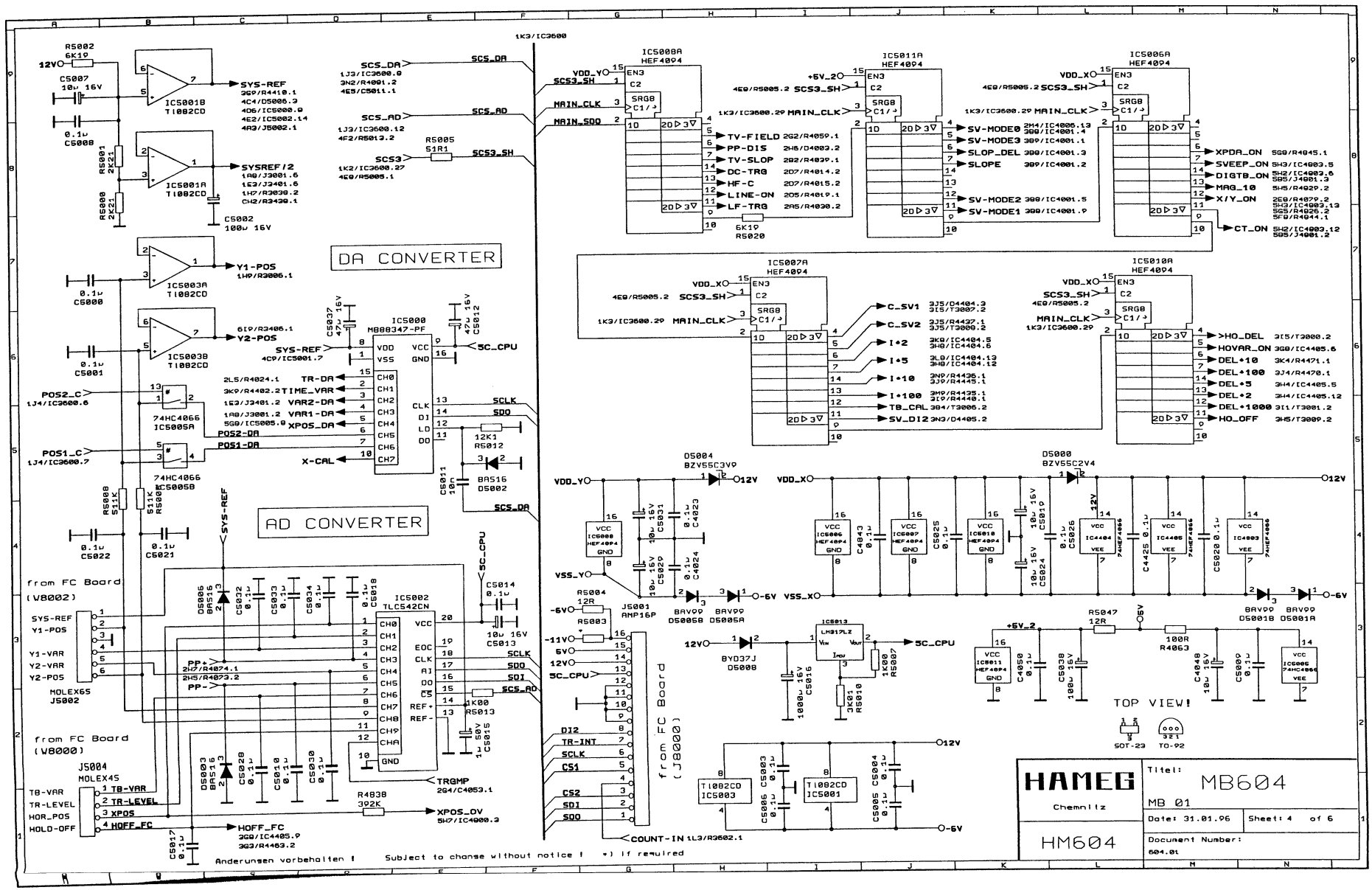
Subject to change without notice


CH1 INTERMEDIATE AMPLIFIER
CH2 INTERMEDIATE AMPLIFIER
TRIGGER-PICK-OFF
From AT Board (V2000)
From AT Board (V2400)
From AT Board (V2200)
To DS-Board J3603
To YF-Board (JP0001)
To CR Board (V6000)
IC3600 EPM7032-15
HAMEG
Chemnitz
HM604
MB604
MB 01
Date: 31.01.96
Sheet: 1 of 6
Document Number: 604.01
Änderungen vorbehalten ! Subject to change without notice ! *) If required
TOP VIEW!
SOT-23
TO-92
PLC 44

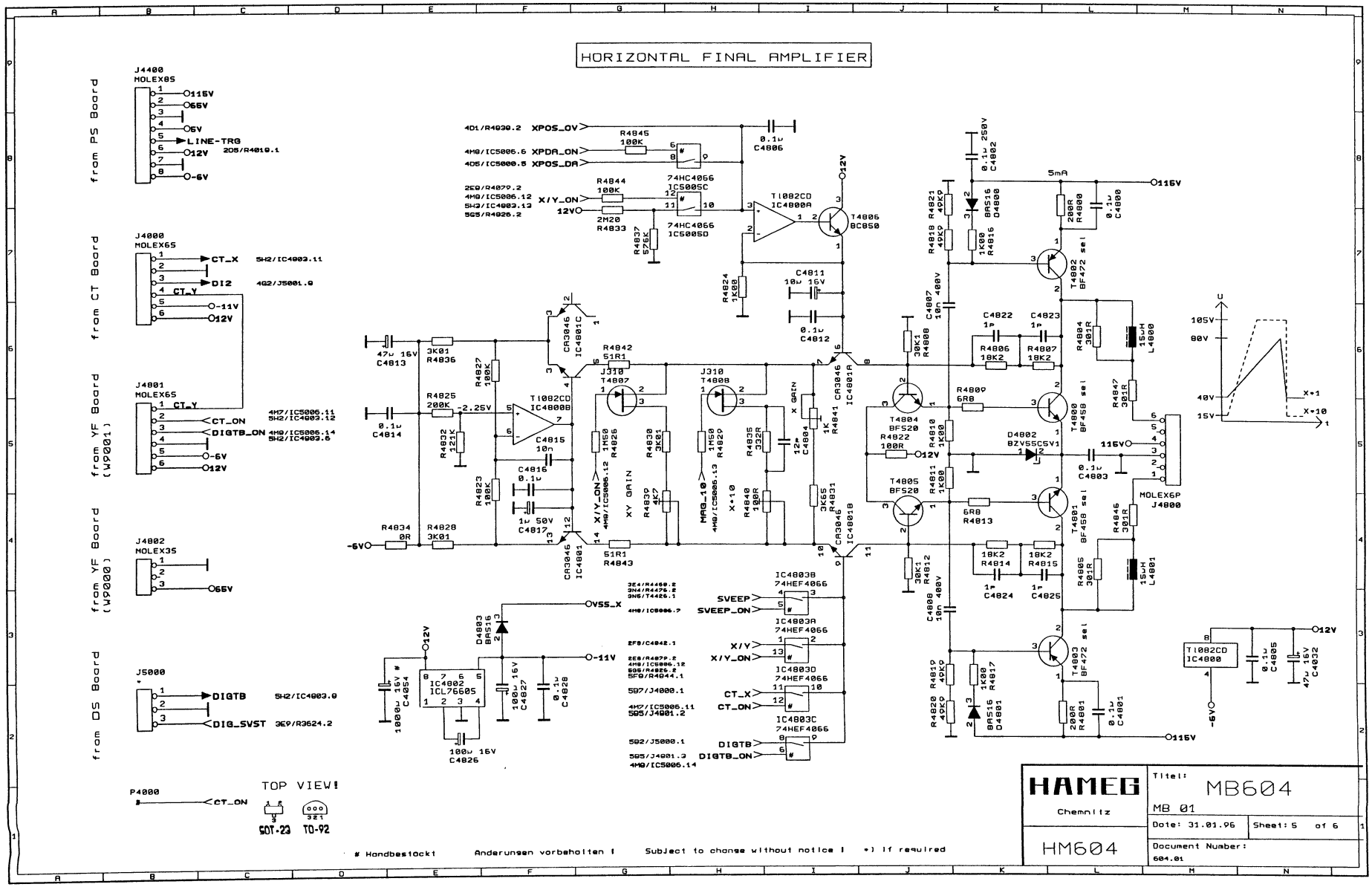


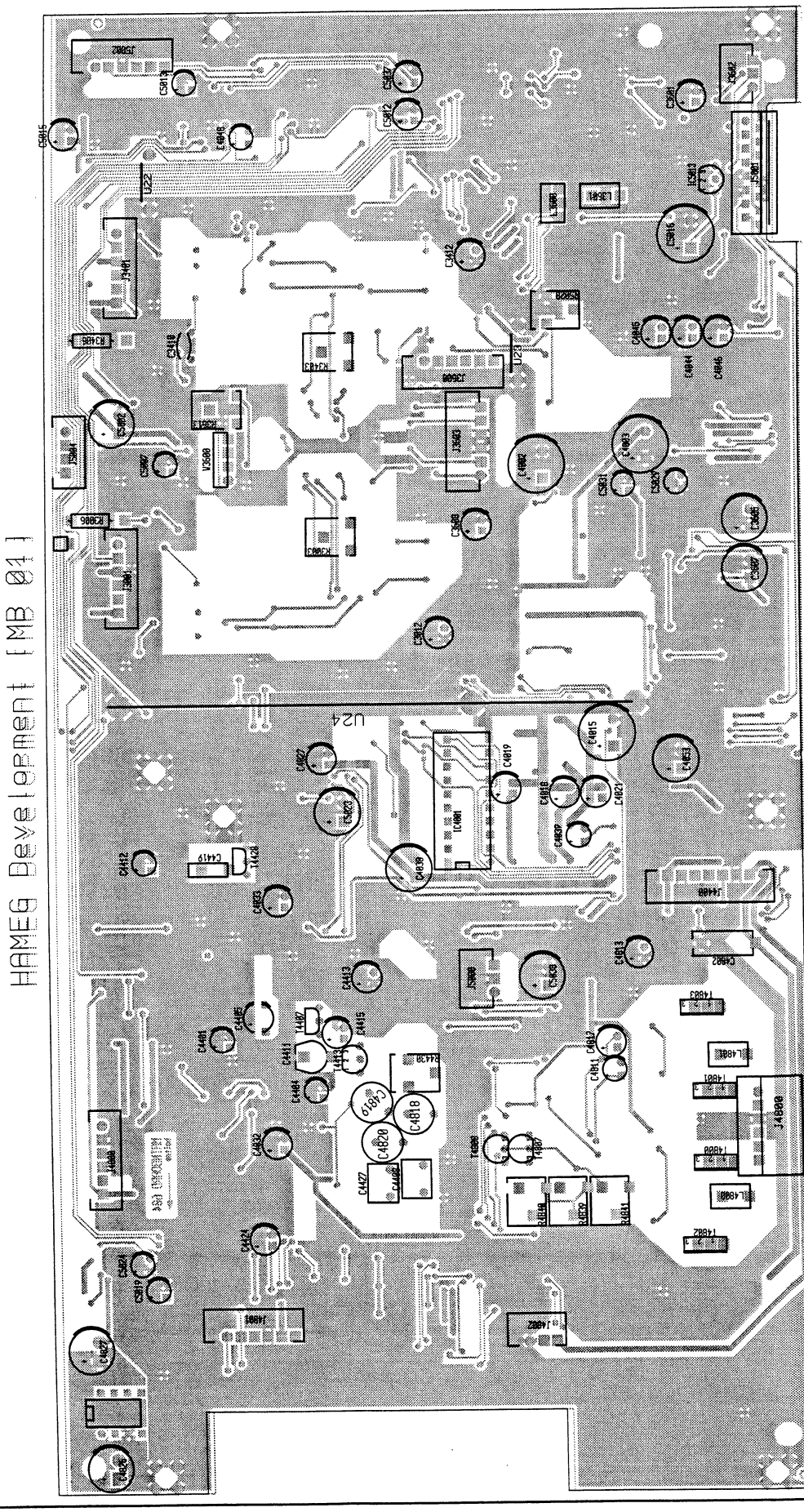
Subject to change without notice


HOLDOFF TIMING
SWEEP GENERATOR
SWEEP DELAY
TOP VIEW!
HAMEG
Chemnitz
HM604
MB604
MB 01
Date: 31.01.96
Sheet: 3 of 6
Document Number:
604.01
Änderungen vorbehalten ! Subject to change without notice ! *) If required

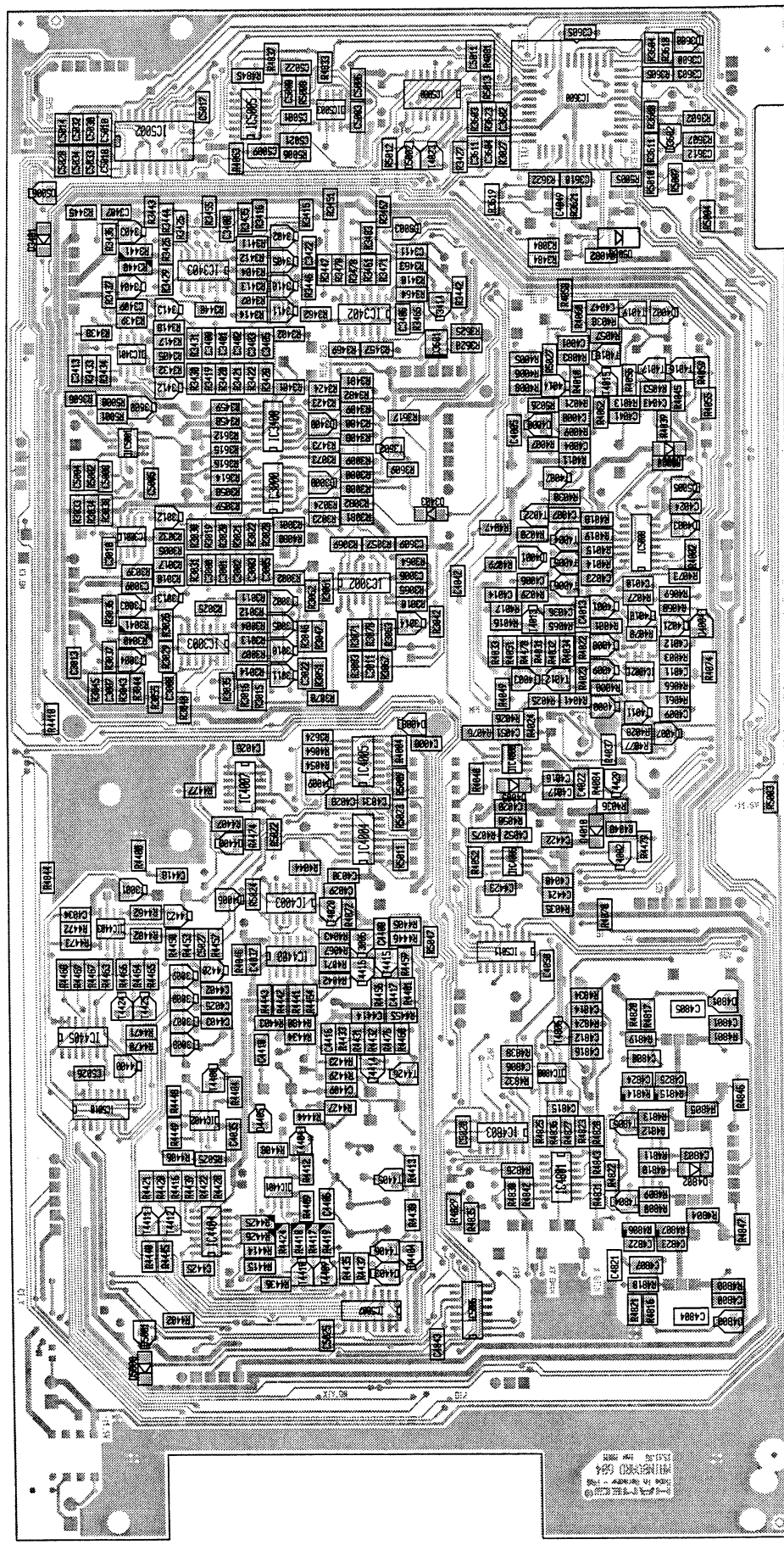


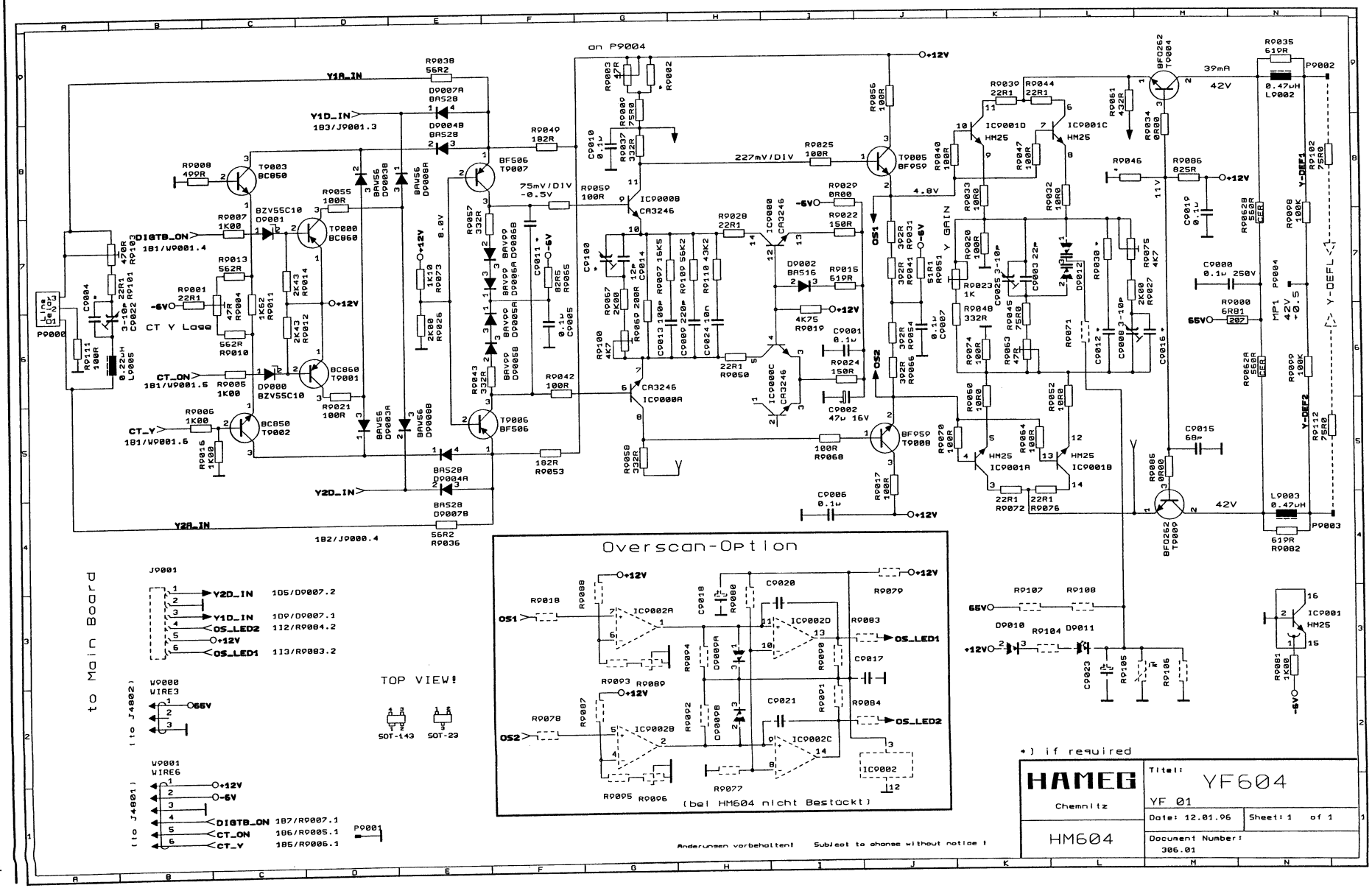
Subject to change without notice

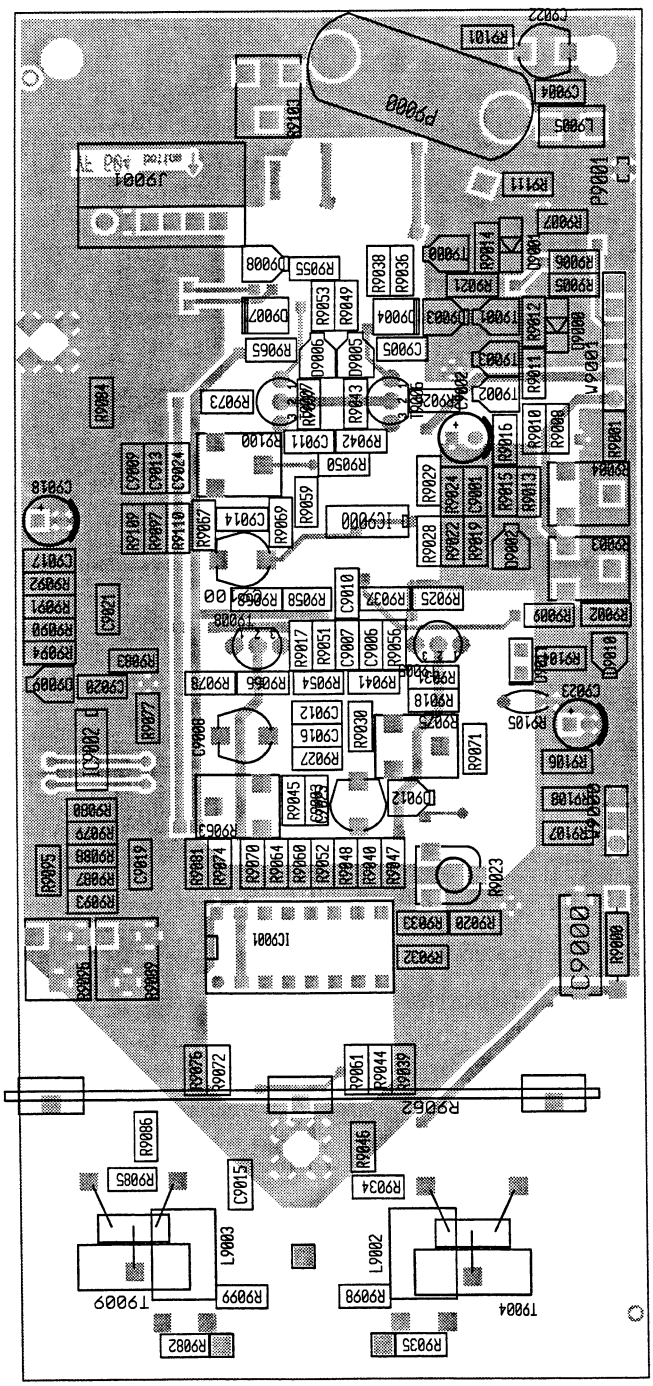

HORIZONTAL FINAL AMPLIFIER
from PS Board
from CT Board
from YF Board (W9001)
from YF Board (W9000)
from DS Board
J4400 MOLEX8S
J4000 MOLEX6S
J4001 MOLEX6S
J4002 MOLEX3S
J5000
P4000
TOP VIEW!
SOT-23
TO-92
HAMEG
Chemnitz
HM604
Titel: MB604
MB 01
Date: 31.01.96
Sheet: 5 of 6
Document Number: 604.01
Handbestückt Änderungen vorbehalten ! Subject to change without notice ! *) If required



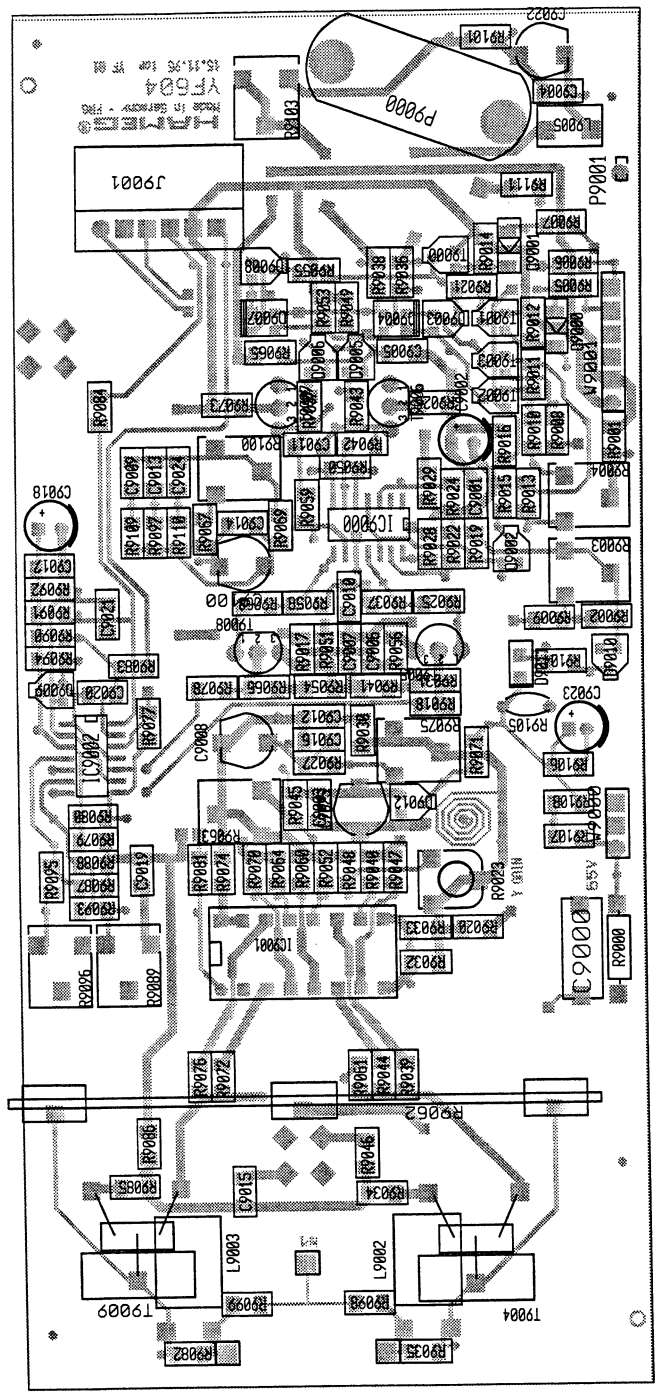
Subject to change without notice


HARMEG Development MB011
SMD Best. Ref. (1.00 03:07:96 MB6041)


Overscan-Option
(bei HM604 nicht Bestückt)
TOP VIEW!
SOT-143
SOT-23
to Main Board
Änderungen vorbehalten! Subject to change without notice !
*) if required
HAMEG
Chemnitz
HM604
Titel: YF604
YF 01
Date: 12.01.96
Sheet: 1 of 1
Document Number: 306.01



YF-Board (Bottomside)



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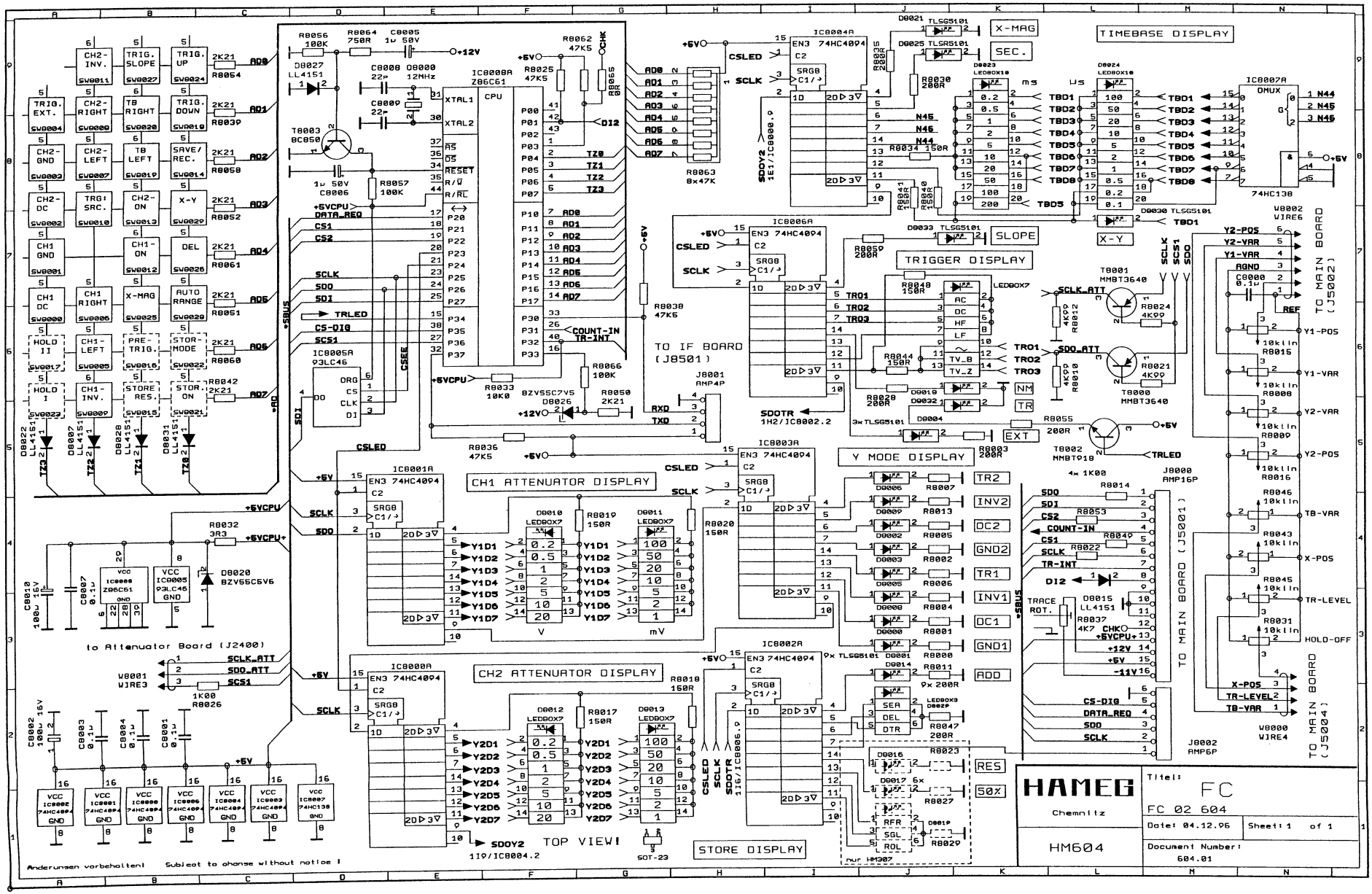
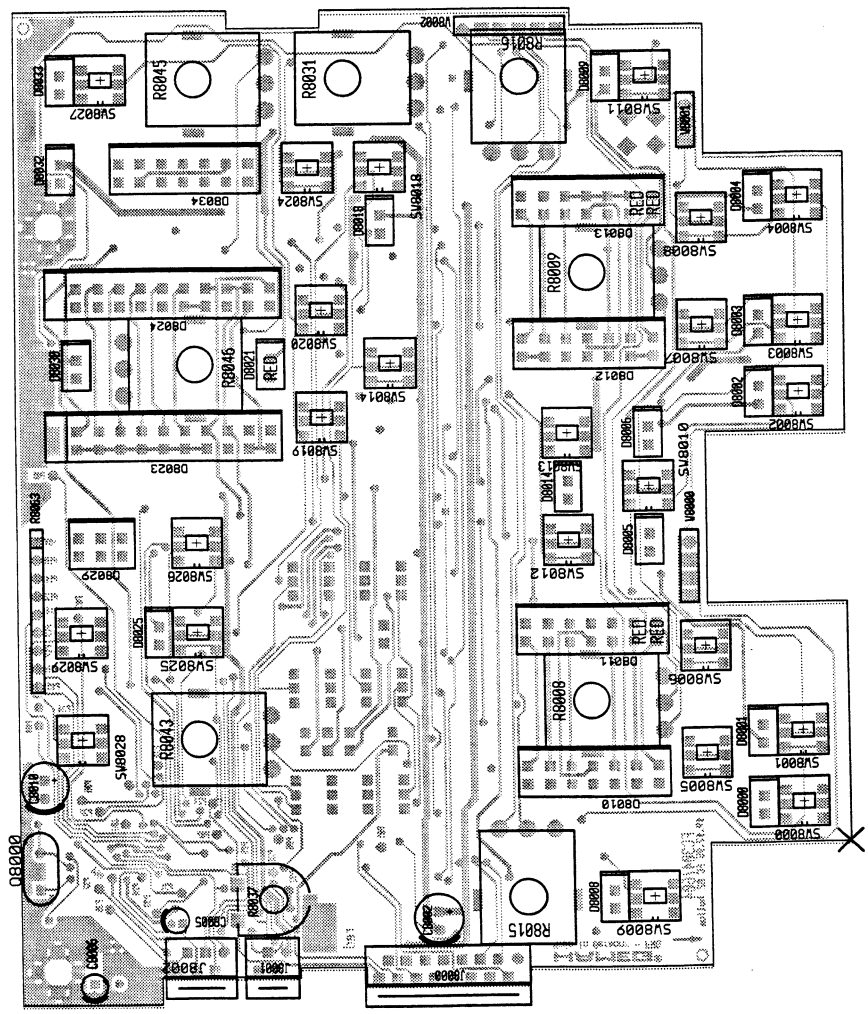
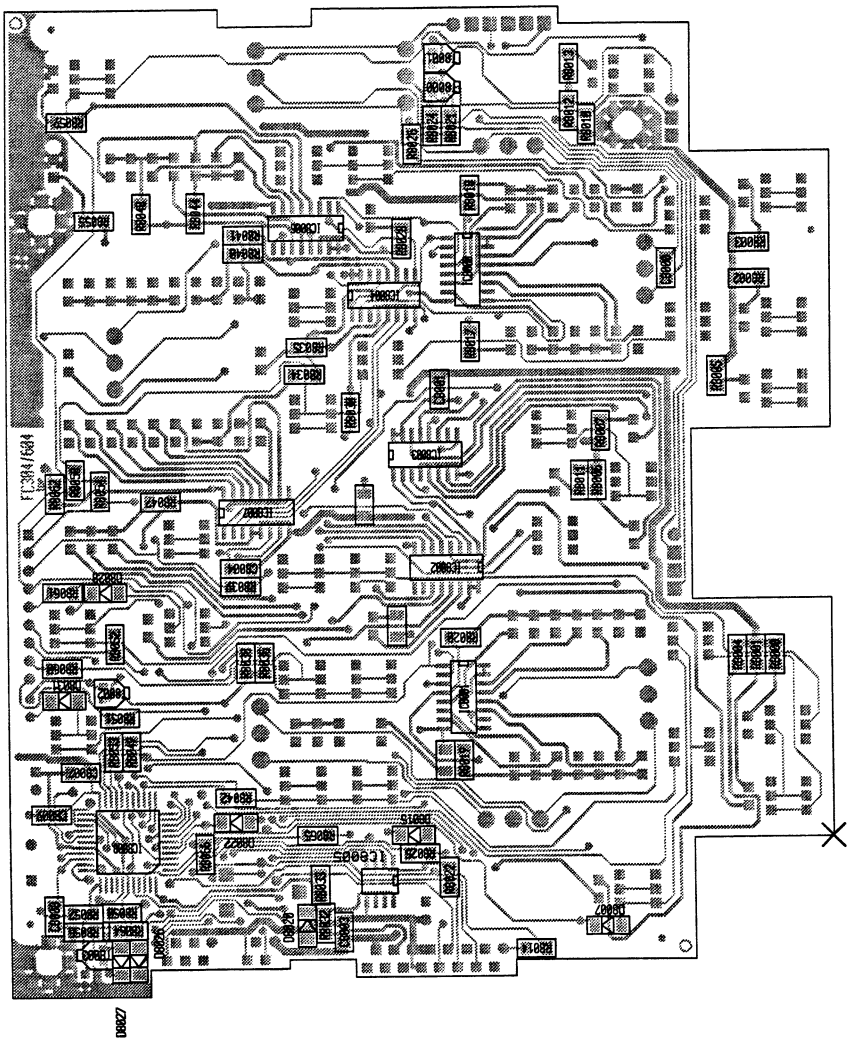
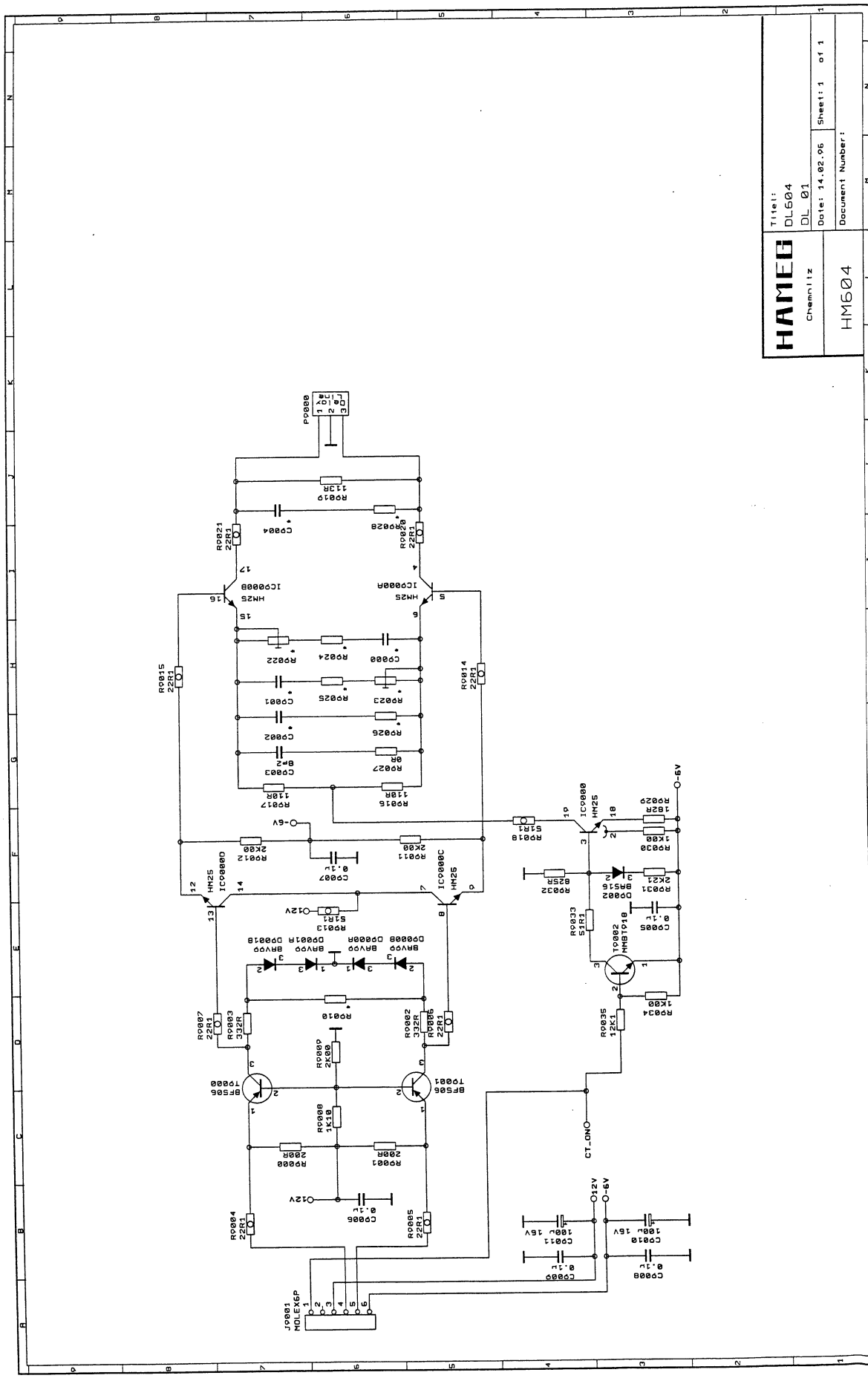

TIMEBASE DISPLAY
TRIGGER DISPLAY
Y MODE DISPLAY
CH1 ATTENUATOR DISPLAY
CH2 ATTENUATOR DISPLAY
STORE DISPLAY
TOP VIEW!
TO IF BOARD (J8501)
to Attenuator Board (J2400)
TO MAIN BOARD (J5002)
TO MAIN BOARD (J5001)
TO MAIN BOARD (J5004)
HAMEG
Chemnitz
HM604
Titel:
FC
FC 02 604
Date: 04.12.96
Sheet: 1 of 1
Document Number:
604.01
Änderungen vorbehalten! Subject to change without notice!

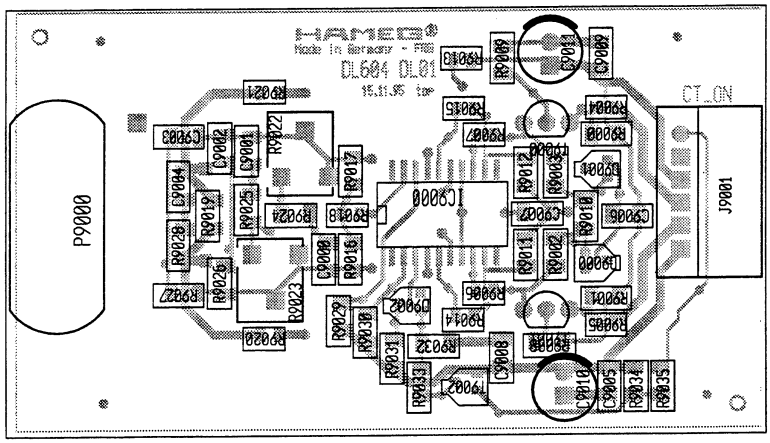


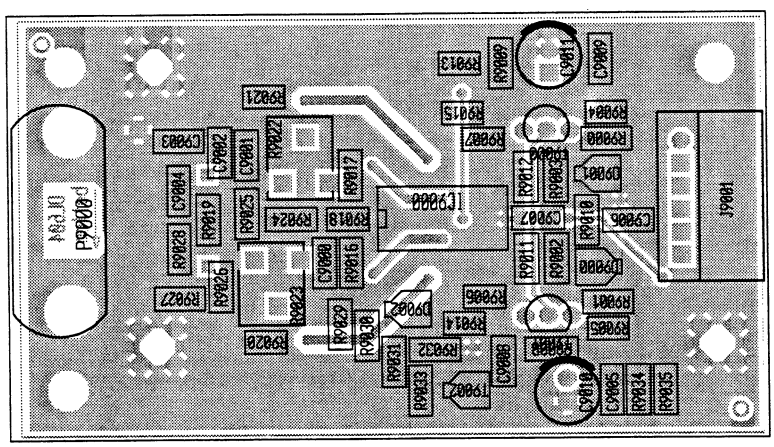


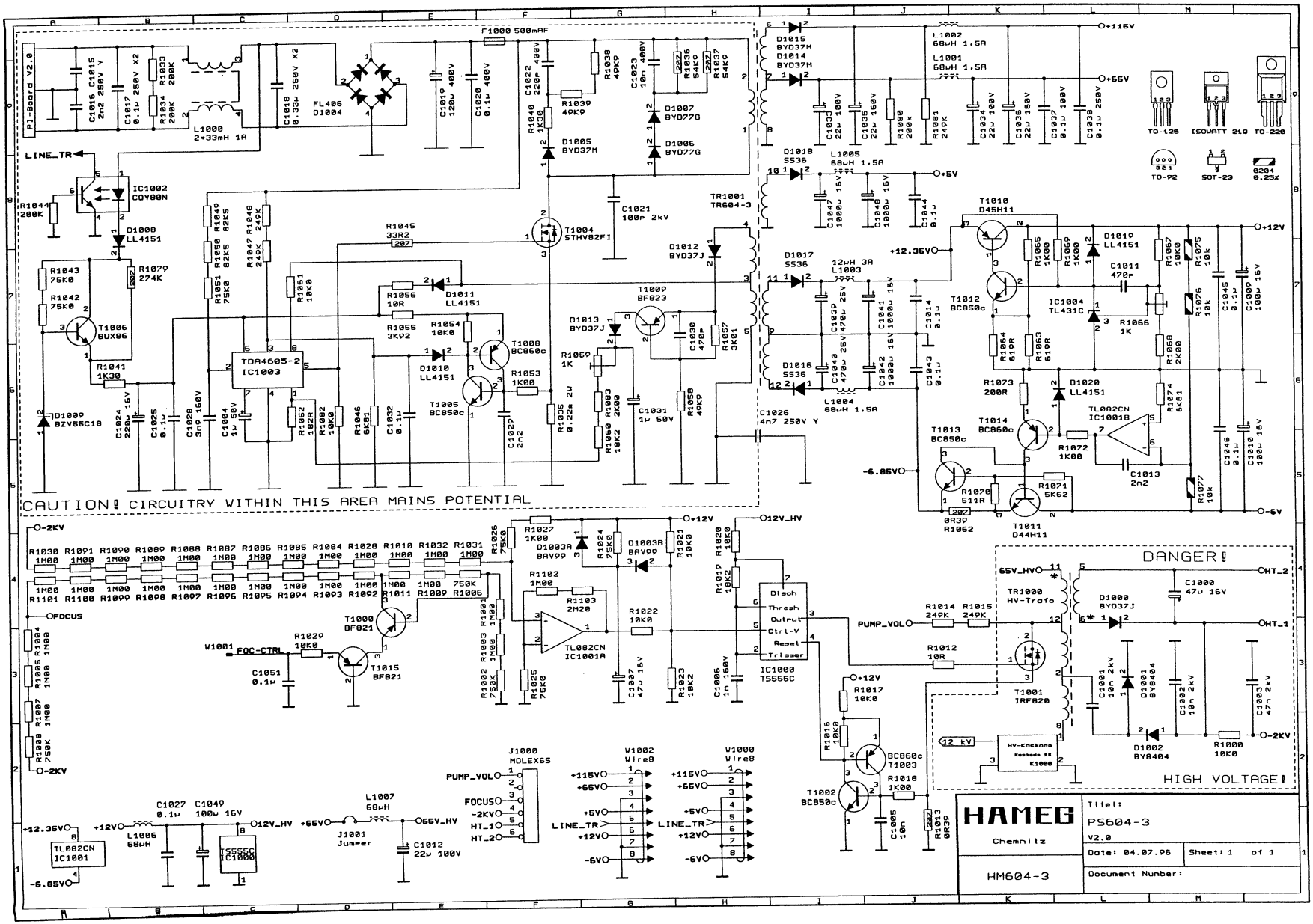


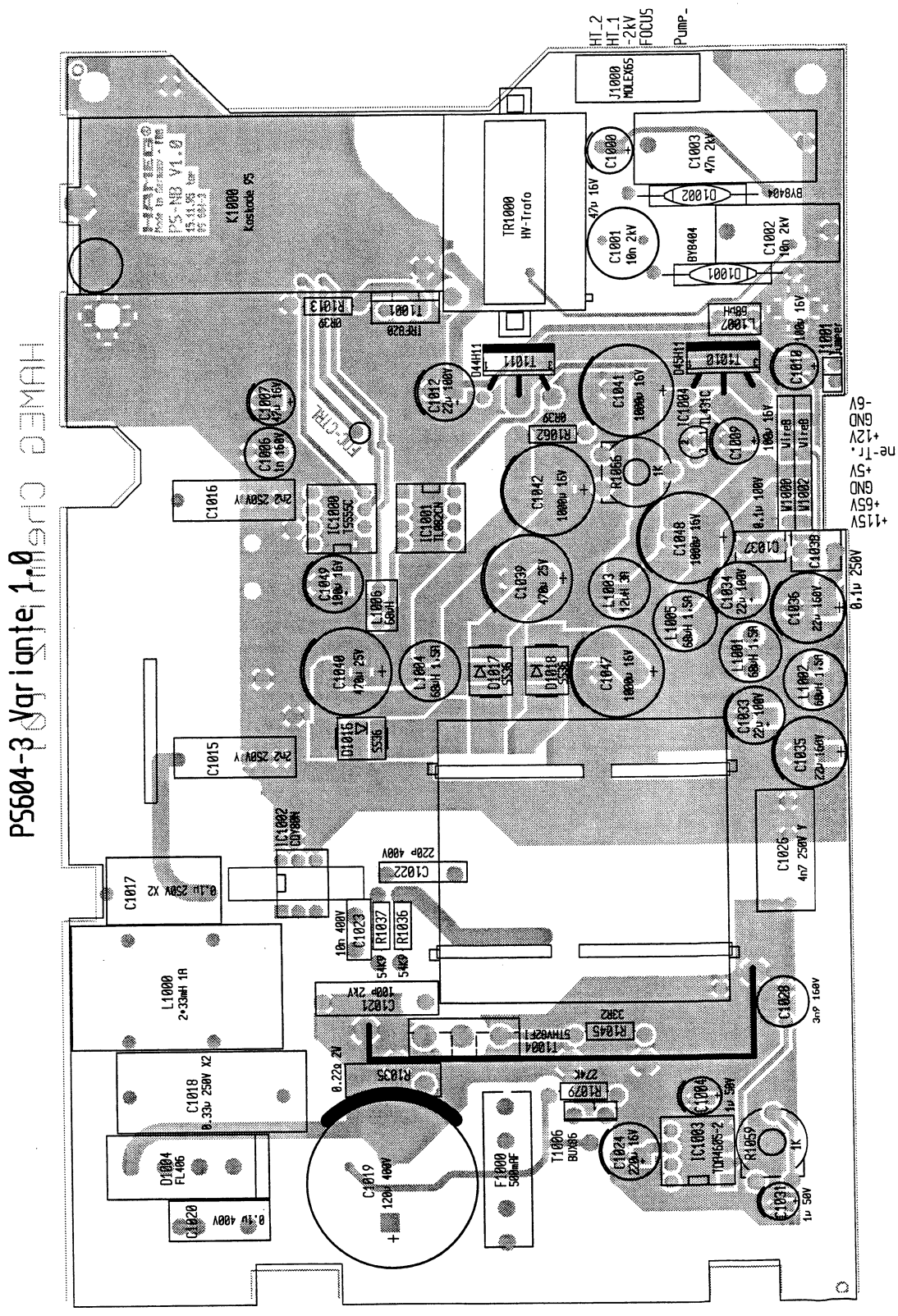
Subject to change without notice

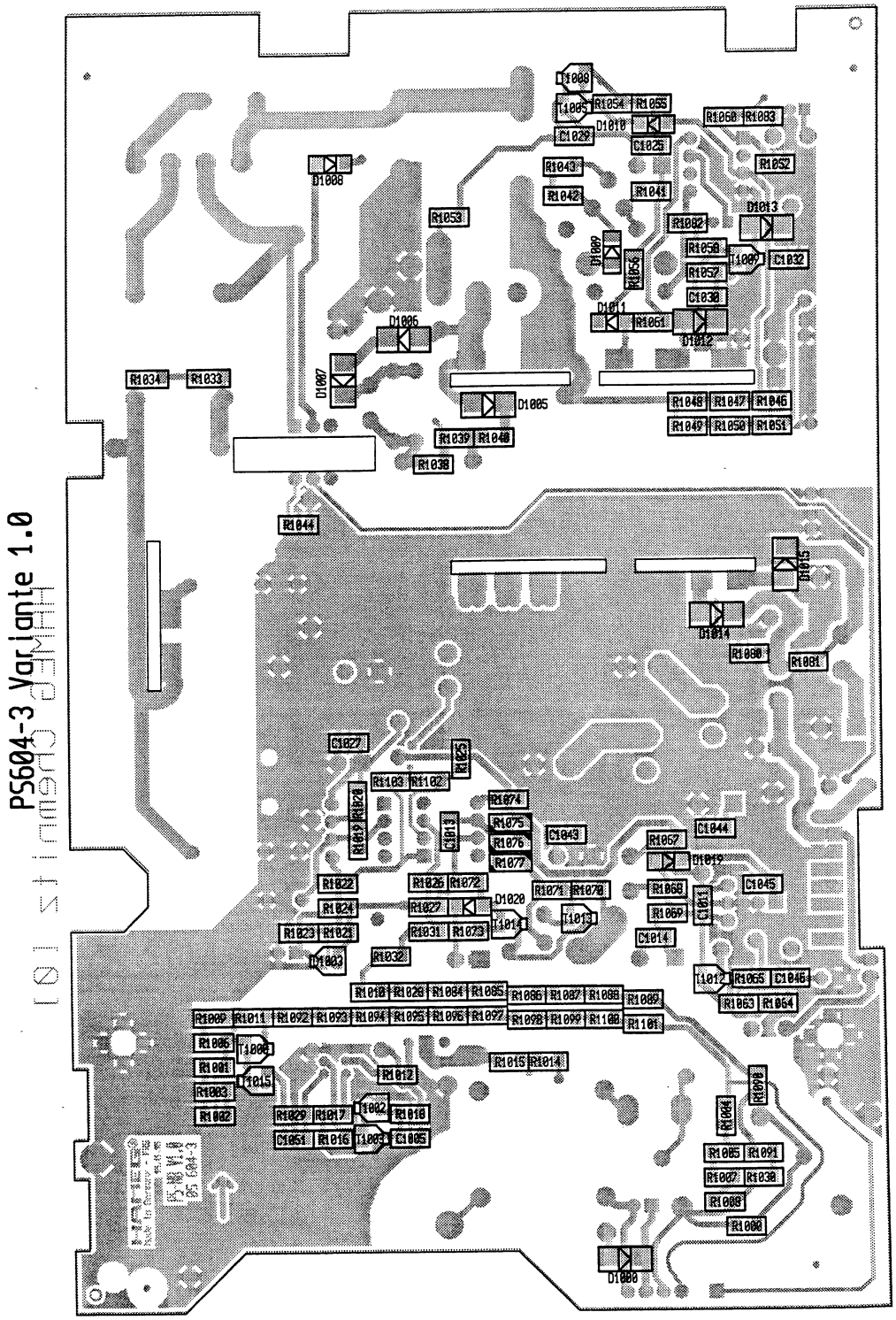
DL-Board (Bottomside and Topside)



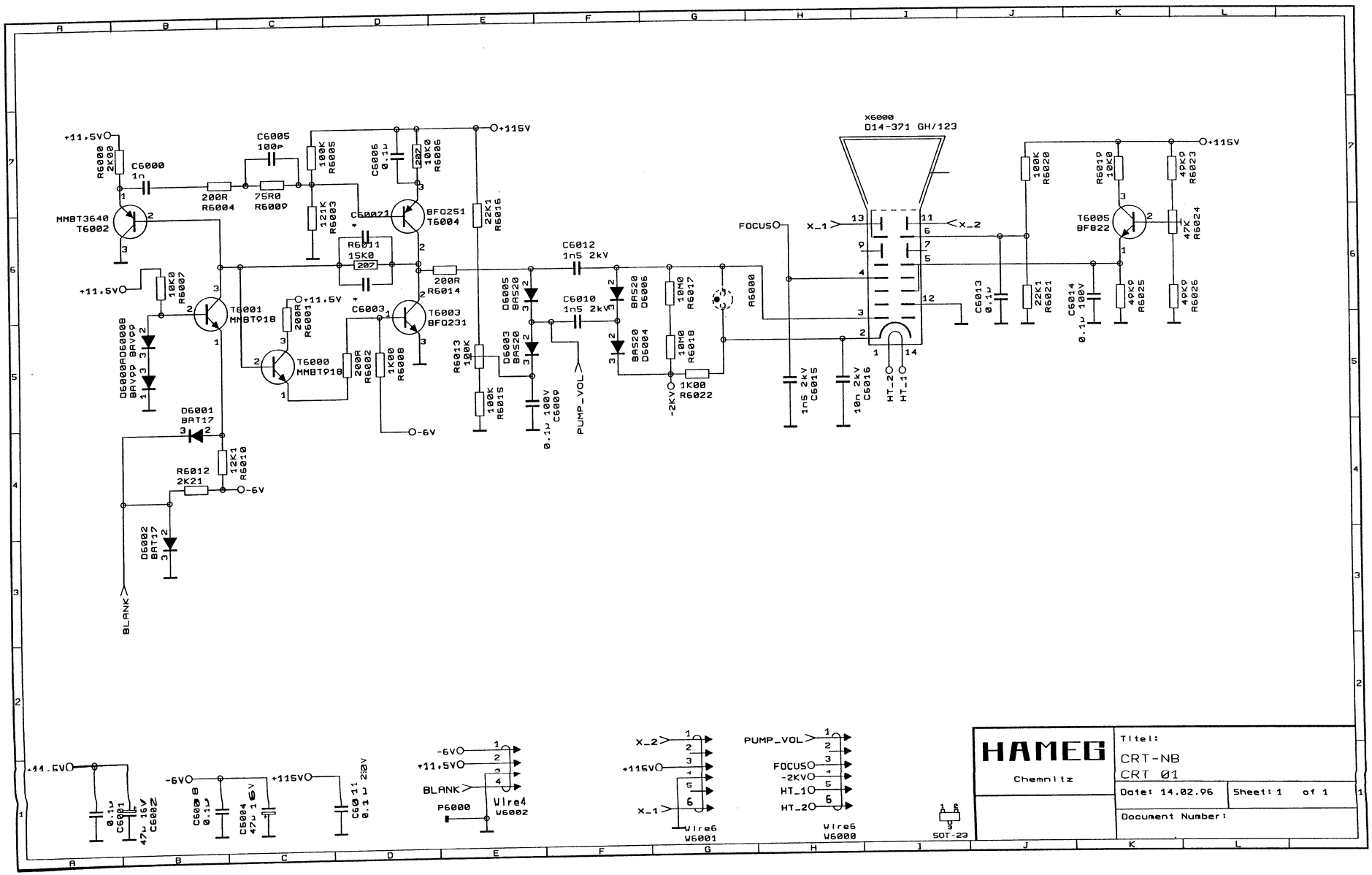


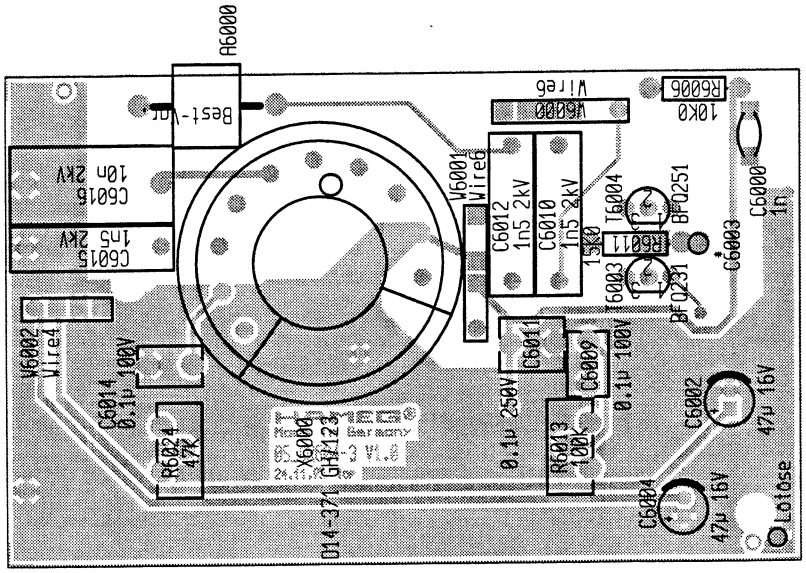

CAUTION! CIRCUITRY WITHIN THIS AREA MAINS POTENTIAL
DANGER!
HIGH VOLTAGE!
HAMEG
Chemnitz
HM604-3
Titel:
PS604-3
V2.0
Date: 04.07.96
Sheet: 1 of 1
Document Number:
TR1000 HV-Trafo
IC1000 TS555C
IC1001 TL082CN
IC1002 COY80N
IC1003 TDA4605-2
T1001 IRF820
T1002 BC850c
T1003 BC860c
T1004 STHV82FI
T1005 BC850c
T1006 BUX86
T1008 BC860c
T1009 BF823
T1010 D45H11
T1011 D44H11
T1012 BC850c
T1013 BC850c
T1014 BC860c
T1015 BF821
TR1001 TR604-3
L1000 2*33mH 1A
L1001 68µH 1.5A
L1002 68µH 1.5A
L1003 12µH 3A
L1004 68µH 1.5A
L1005 68µH 1.5A
L1006 68µH
L1007 68µH
F1000 500mAF
J1000 MOLEX6S
J1001 Jumper
W1000 Wire8
W1002 Wire8
W1001 FOC-CTRL
+115V
+65V
+12.35V
+12V
+5V
-6.85V
-5V
-2KV
12V_HV
65V_HV
PUMP_VOL
FOCUS
LINE_TR
HT_1
HT_2
TO-126
ISOWATT 218
TO-220
TO-92
SOT-23
0204 0.25x

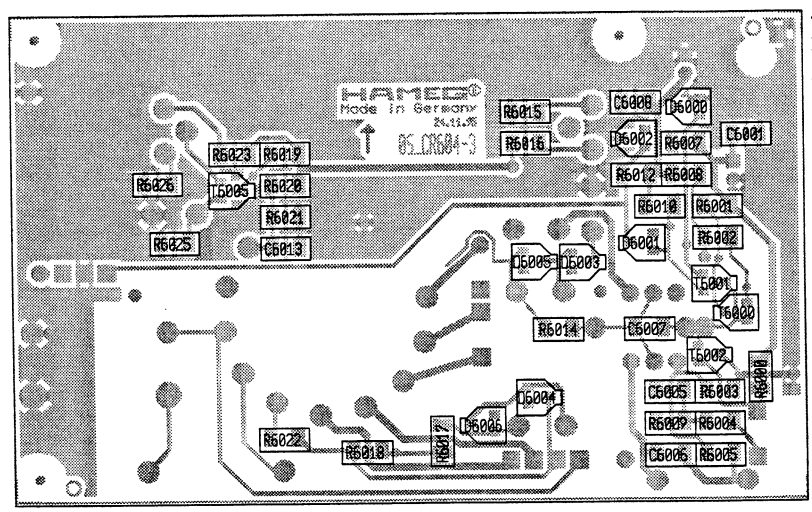

PS604-3 Variante 1.0
HT_2
HT_1
-2kV
FOCUS
PUMP-
J1000
MOLEX65
TR1000
HV-Trafo
K1000
Kastrole PS
C1000
C1003
47n 2kV
C1001
10n 2kV
C1002
10n 2kV
D1002
BY8404
D1001
BY8404
C1010
C1041
C1042
C1018
C1039
C1040
C1016
C1015
C1017
C1026
4n7 250V Y
L1000
2*33mH 1A
C1018
0.33µ 250V X2
D1004
FL406
C1020
0.1µ 400V
C1019
120µ 400V
F1000
500mAF
T1006
BU486
C1024
220µ 16V
IC1003
TDA4605-2
R1059
1K
C1031
1µ 50V
C1021
100p 2kV
R1035
0.22Ω 2W
R1037
R1036
5K9
5K9
C1023
10n 400V
C1022
220p 400V
C1028
3n9 1600V
R1045
33K2
T1004
STW82FI
R1029
27K
C1007
C1006
C1012
22µ 160V
T1001
T1010
D1027
C1038
C1034
22µ 100V
C1036
22µ 160V
C1033
22µ 100V
C1035
22µ 160V
L1001
L1002
L1003
L1004
L1005
L1006
D1017
D1018
D1015
C1019
C1000
IC1001
TL431C
R1062
R1065
1K
C1008
C1009
R1000
R1002
L1007
C1001
IC1000
IC1002
D1027
C1038
+115V
+65V
GND
+5V
GND
+12V
GND
-6V
Ine-Tr.
0.1µ 250V



Subject to change without notice


+11,5V
+115V
-6V
BLANK
PUMP_VOL
FOCUS
-2KV
HT_1
HT_2
X_1
X_2
X6000
D14-371 GH/123
MMBT3640
T6002
T6001
MMBT918
T6000
MMBT918
T6004
BF0251
T6003
BF0231
T6005
BF822
D6001
BAT17
D6002
BAT17
D6000A
D6000B
BAV99
BAV99
D6003
BAS20
D6004
BAS20
D6005
BAS20
D6006
BAS20
R6000 2K00
C6000 1n
C6005 100p
R6004 200R
R6009 75R0
R6005 100K
R6003 121K
C6006 0.1µ
R6006 10K0
C6007 202
R6011 15K0
R6016 22K1
R6014 200R
R6007 10K0
R6001 200R
R6002 200R
R6008 1K00
C6003
R6013 100K
R6015 100K
C6008 0.1µ 100V
R6010 12K1
R6012 2K21
C6012 1n5 2kV
C6010 1n5 2kV
R6017 10M0
R6018 10M0
R6022 1K00
R6000
C6015 1n5 2kV
C6016 10n 2kV
R6020 100K
R6021 22K1
C6013 0.1µ
C6014 0.1µ 100V
R6019 10K0
R6025 40K9
R6023 40K9
R6024 47K
R6026 40K9
C6001 0.1µ
C6002 47µ 16V
C6004 47µ 16V
C6009 0.1µ 250V
P6000
W6002
W6001
W6000
SOT-23
HAMEG
Chemnitz
Titel:
CRT-NB
CRT 01
Date: 14.02.96
Sheet: 1 of 1
Document Number:





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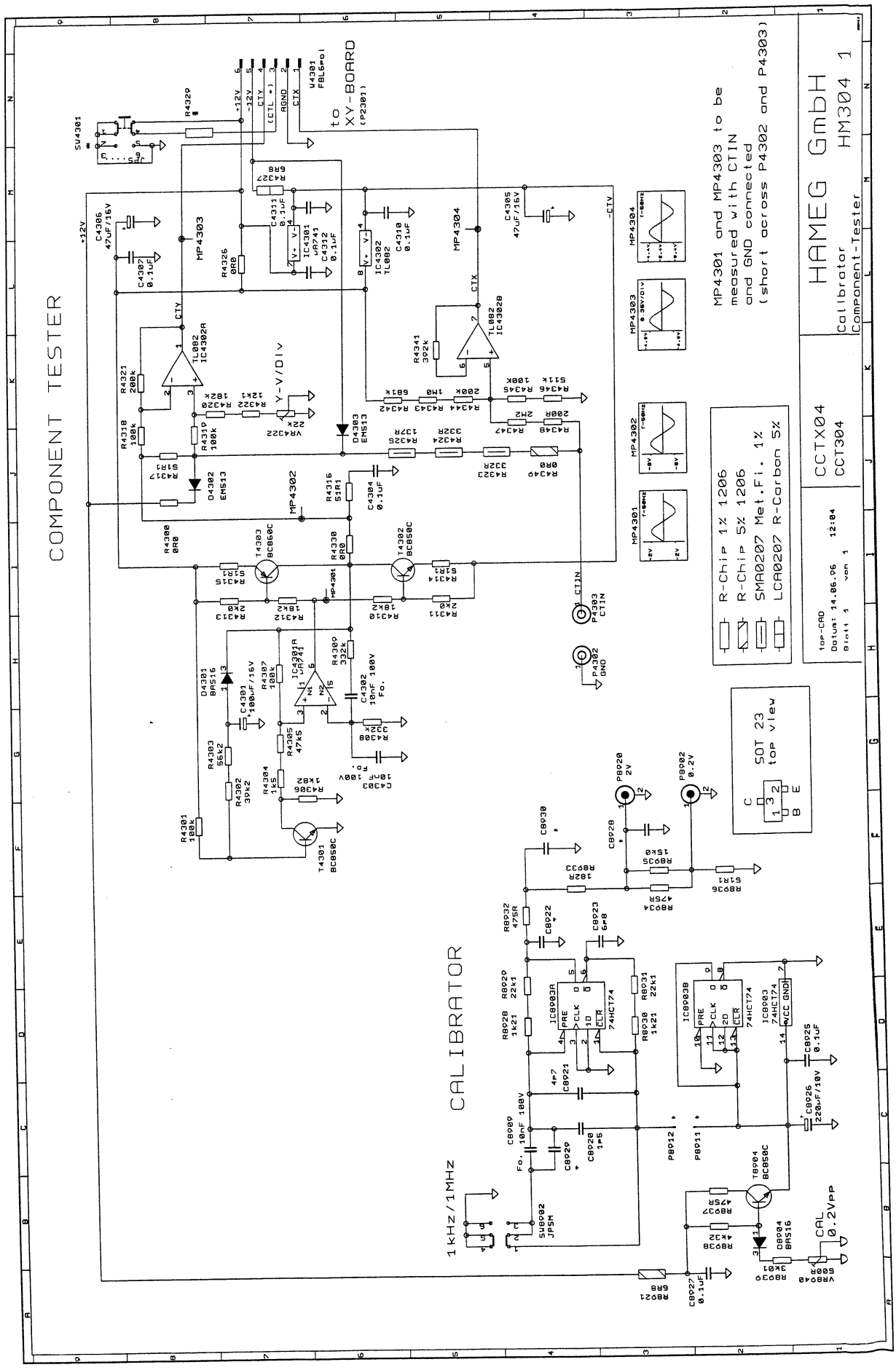
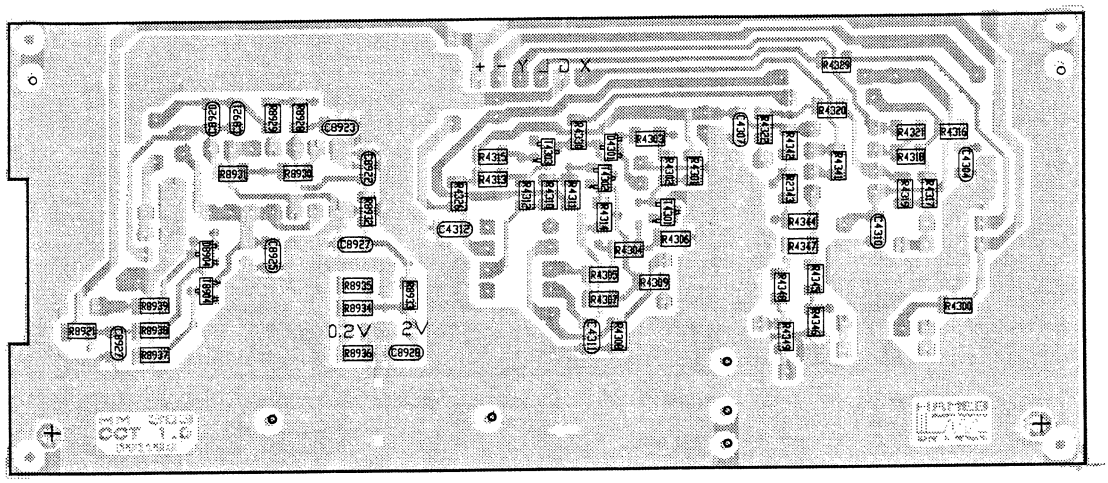
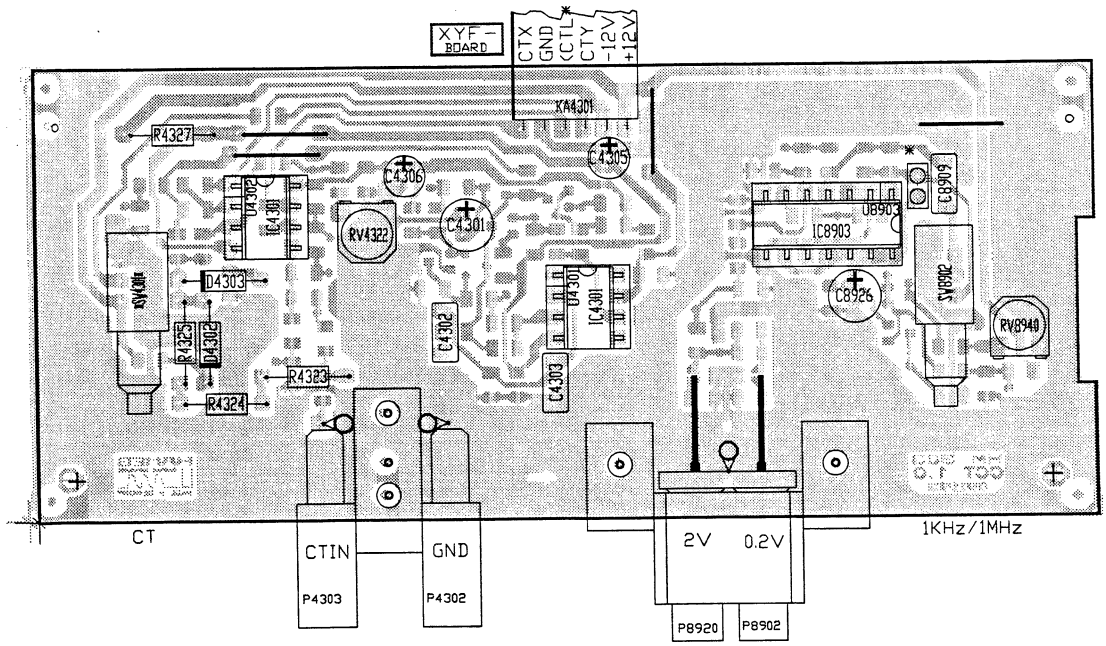

COMPONENT TESTER
CAL IBRATOR
to XY-BOARD (P2301)
MP4301 and MP4303 to be measured with CTIN and GND connected (short across P4302 and P4303)
R-Chip 1% 1206
R-Chip 5% 1206
SMA0207 Met.Fi. 1%
LCA0207 R-Carbon 5%
HAMEG GmbH
Calibrator
Component-Tester
HM304 1
CCTX04
CCT304
1kHz/1MHz
CAL
0.2Vpp
SOT 23
top view





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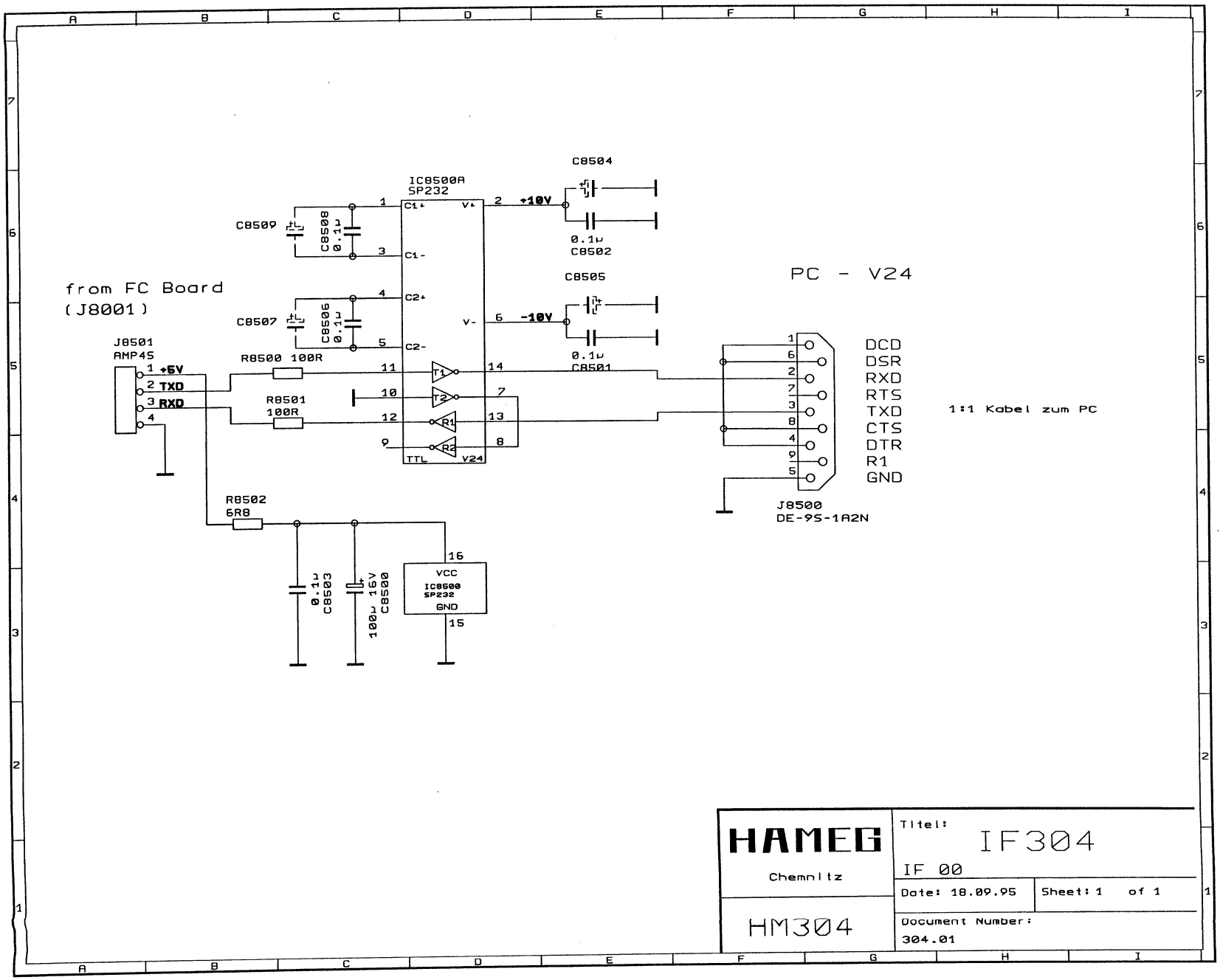
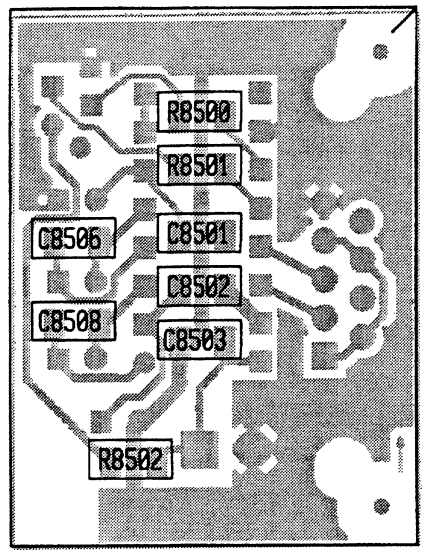
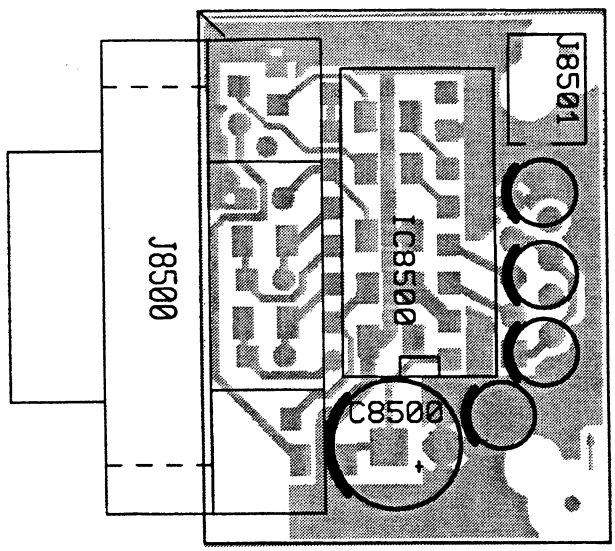

from FC Board
(J8001)
J8501
AMP4S
1 +5V
2 TXD
3 RXD
4
R8500 100R
R8501
100R
R8502
6R8
IC8500A
SP232
C1+
C1-
C2+
C2-
V+
V-
T1
T2
R1
R2
TTL
V24
C8504
C8509
C8508
0.1µ
C8502
C8505
C8507
C8506
0.1µ
C8501
+10V
-10V
11
10
12
9
14
7
13
8
1
2
3
4
5
6
C8503
0.1µ
C8500
100µ 16V
VCC
IC8500
SP232
GND
16
15
PC - V24
DCD
DSR
RXD
RTS
TXD
CTS
DTR
R1
GND
1:1 Kabel zum PC
J8500
DE-9S-1A2N
HAMEG
Chemnitz
HM304
Titel:
IF304
IF 00
Date: 18.09.95
Sheet: 1 of 1
Document Number:
304.01





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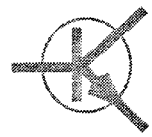

Adjustment Procedure

HM604-3

ADJUSTMENT PROCEDURE

Analog Scope HM604-3

WARNING

The Instrument must be disconnected from the mains power supply whenever you open the case, repair or exchange parts.

HIGH VOLTAGE WARNING!

Hazardous High Voltage of up to 12,000 Volts is present inside this Instrument. The areas particularly affected by High Voltage are the high voltage circuit on the PS-board, the CRT anode contact and the CRT-board.

SERVICE AND ADJUSTMENT

- of this instrument should only be performed in accordance and in conjunction with the operating manual and the WARNINGS contained therein, particularly „Service Instructions" and „Operating Instructions".
- should only be performed by suitable qualified and experienced service personnel, or should be referred to one of the HAMEG companies listed on the rear cover of the manual.

Test Instruments required:

1) Scope Tester HZ 60-2.
2) Constant amplitude sinewave generator, 20Hz - 250MHz, output 5mV - 5V into 50Ω, preferably with 20dB attenuation (e.g. HM 8133, TEK SG502 + TEK SG503).
3) Amplitude Calibrator with 1kHz square wave output and 600Ω impedance, risetime faster than 150ns. Output voltage 2mV - 20Volts in 1-2-5 sequence for 4 divisions display amplitude (e.g. HZ62, TEK PG506).
4) Time mark generator from 5ns/div to 5s/div. Output min. 10mV into 50Ω (e.g. HZ62, TEK TG501).
5) Pre-attenuator 2:1 (1 MΩ parallel with 12-48pF), e.g. HZ20.
6) 50Ω BNC through termination, e.g. HZ22.
7) 2 BNC-cables, 50Ω, e.g. HZ34.
8) BNC-T-connector.
9) Oscilloscope probe 10:1, with exactly 9MΩ series resistance and compensated for test oscilloscope mentioned under 10).
10) Oscilloscope 100MHz, 5mV/div to 5V/div, e.g. HM1005.
11) Trimming/adjusting tool.
12) Variable output safety insulation transformer.
13) Video signal generator with positive and negative signal output.

This procedure covers all adjustments and the most important - but not all - performance checks. The correct sequence of all adjustment steps must be strictly followed.

Exact adjustment is only possible when any influence of the earths' magnetic field has been compensated with the trimmer marked TR (trace rotation).

All adjustments should only be performed by qualified and experienced personnel. This is particularly important for adjustments in the high voltage section of the instrument.

1) R1059: +115 Volt supply. 35
2) R1066: +12 Volt supply. 35
3) R8037: Trace Rotation Check. 35
4) R6013: CRT minimum intensity. 35
5) R9003: Mean Y-plate Potential. 35
6) R6024 : Astigmatism correction. 35
7) R9023: Y-Gain CH I. 37
8) R2189: FET operating point CH I. 37
9) R2141: Invert-Balance CH I. 37
10) R2131: Variable-Balance CH I. 37
11) R2000: 10Hz Squarewave 5mV/div CH I. 37
12) R2002: 10Hz Squarewave 1mV/div Adjustment CH I. 37
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15) R2341: Invert-Balance CH II. 39
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34) VR8940: Calibrator Output. 47
35) Trigger Filter Check. 47
36) Triggerbandwidth Check. 48
37) External Trigger Check. 48

NOTE
The adjustment procedures assume that the instrument had once been properly adjusted in the factory and adjustments are required due to temperature drift or the replacement of defective components.

Before starting each adjustment procedure, set the oscilloscope to the following basic settings:

X-Section:

TIME/DIV.	0.1µs
TIME VAR.	calibrated detent (fully cw)
NORM (trigger)	off
TRIG. (coupling)	AC
TRIG. LEVEL	mechanical center position
TRIG. (SLOPE)	+ (- LED dark)
HOLD OFF	x1
XY	off
X-POS.	mechanical center position
X-MAG. x10	off
DELAY (mode)	off

Y-Section:

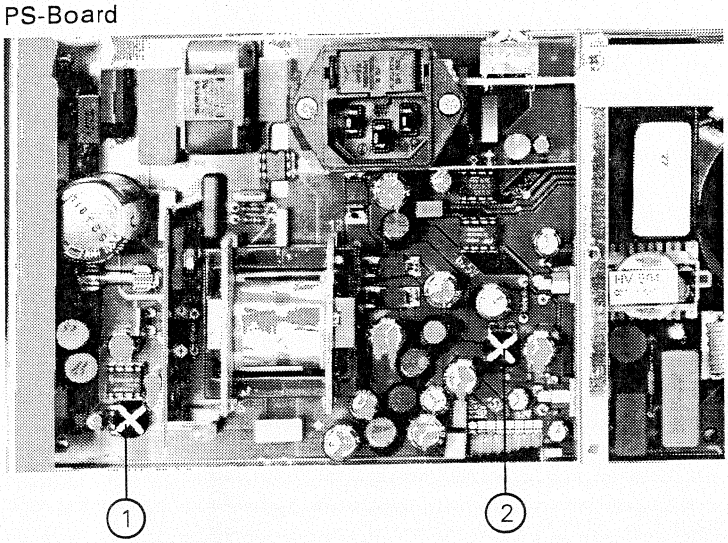
CH I	on, 5mV/div, calibrated, DC input coupling
CH II	off, 5mV/div, calibrated, DC input coupling
INV CH I & II	off
Y-POS I & II	mechanical center position
EXTern (trigger)	off

COMP. TESTER & CAL-Section

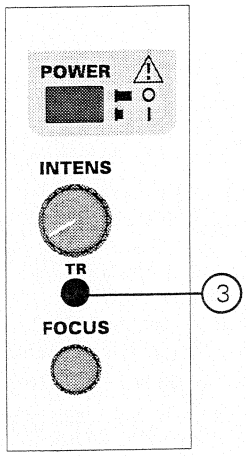
COMPONENT TESTER	off
CALIBRATOR	1 kHz

If different settings are required, they are mentioned particularly for each subject.

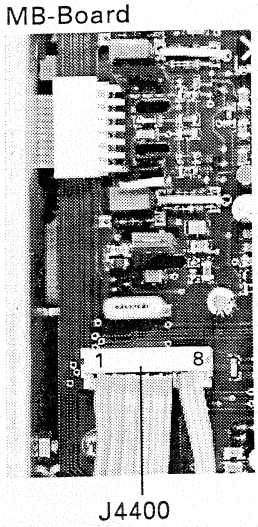
PS-Board



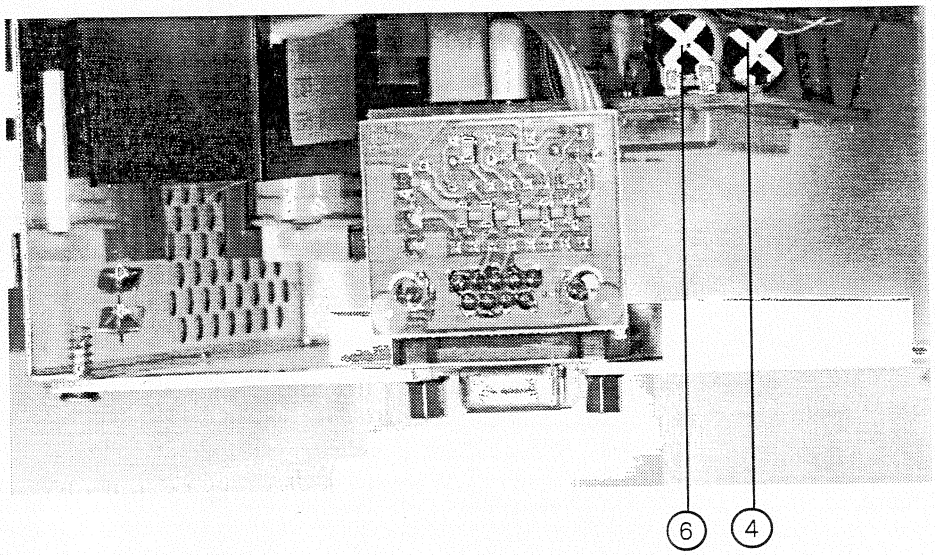
FC-Board HM604-3



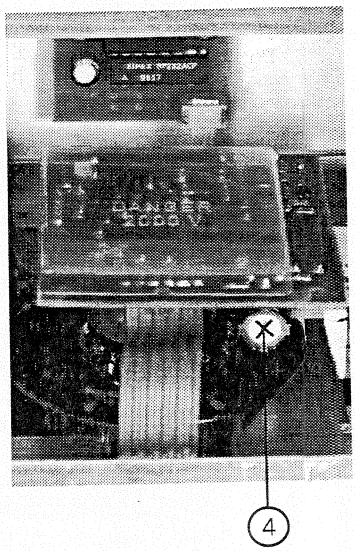
MB-Board



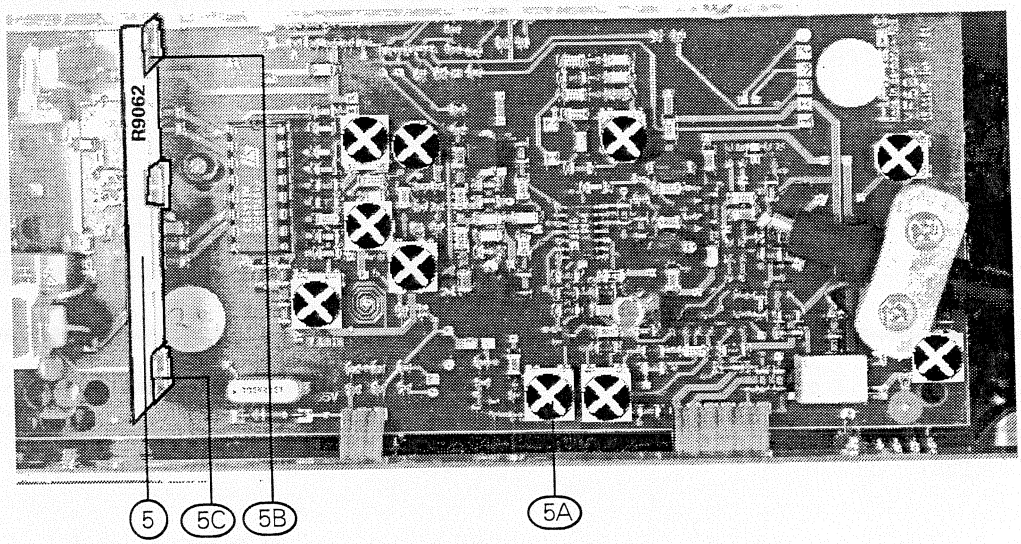
CRT-Board (Top side)



CRT-Board (Bottom side)



YF-Board



Subject to change without notice

1) R1059: +115 Volt supply.

WARNING: To avoid damage use a fully insulated screwdriver!
Locate and identify R1059 (1) on PS-Board (screened section).
Locate connector J4400 (8pole Molex) on MB-Board and identify pin 1.
Adjust R1008 (1) for exactly +115 Volts (± 0.1 Volt) at J4400 pin 1 with respect to chassis.

2) R1066: +12 Volt supply.

Locate and identify R1016 (2) on PS-Board.
Locate connector J4400 (8pole Molex) on MB-Board and identify pin 6.
Adjust R1016 (2) for exactly +12 Volts (± 10mV) at J4400 pin 6 with respect to chassis.
At J4400 the other voltages +65V (pin 2), -6V (pin 8), +5V (pin 4), -6V (pin 8) and -1950V on cathode of CRT depend on the correct +12 Volt adjustment. All these voltages with higher tolerances must be checked and verified.

3) R8037: Trace Rotation Check.

Locate and identify R8037 (3) „TR" on the front panel.
Press channel I GD pushbutton (GD LED lit).
Rotate R8037 (3) and check that the range of inclination of the baseline is at least 1mm at both horizontal limits of the graticule.
Readjust baseline exactly parallel to the horizontal center line of the graticule.
Press channel I GD pushbutton (GD LED dark).

4) R6013: CRT minimum intensity.

Locate and identify R6013 (4) on CRT-Board.
Set INTENS. control to fully left position.
Press XY pushbutton for XY mode (XY LED lit).
Adjust R6013 (4) so that the dot just disappears.
Press XY pushbutton for time base mode (XY LED dark).

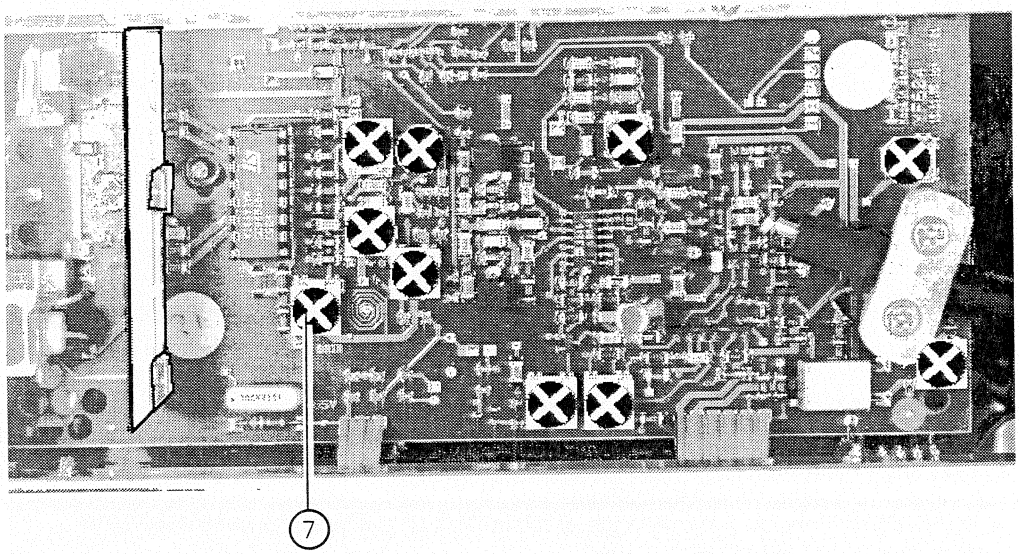
5) R9003: Mean Y-plate Potential.

Locate and identify R9003 (5A) on YF-Board.
Set trace to the horizontal center line.
Switch the oscilloscope OFF.
Locate and identify the ceramic (double) resistor R9062 A and B with the connections 5B and 5C.
Connect 5B and 5C (short) galvanically (wire with crocodile clips).
Switch the oscilloscope ON.
Measure the DC voltage at 5B or 5C with respect to ground.
Adjust R9003 (5A) for +42Volt (± 0.5V).
Switch the oscilloscope OFF.
Remove the short-circuiting wire.
Switch the oscilloscope ON.

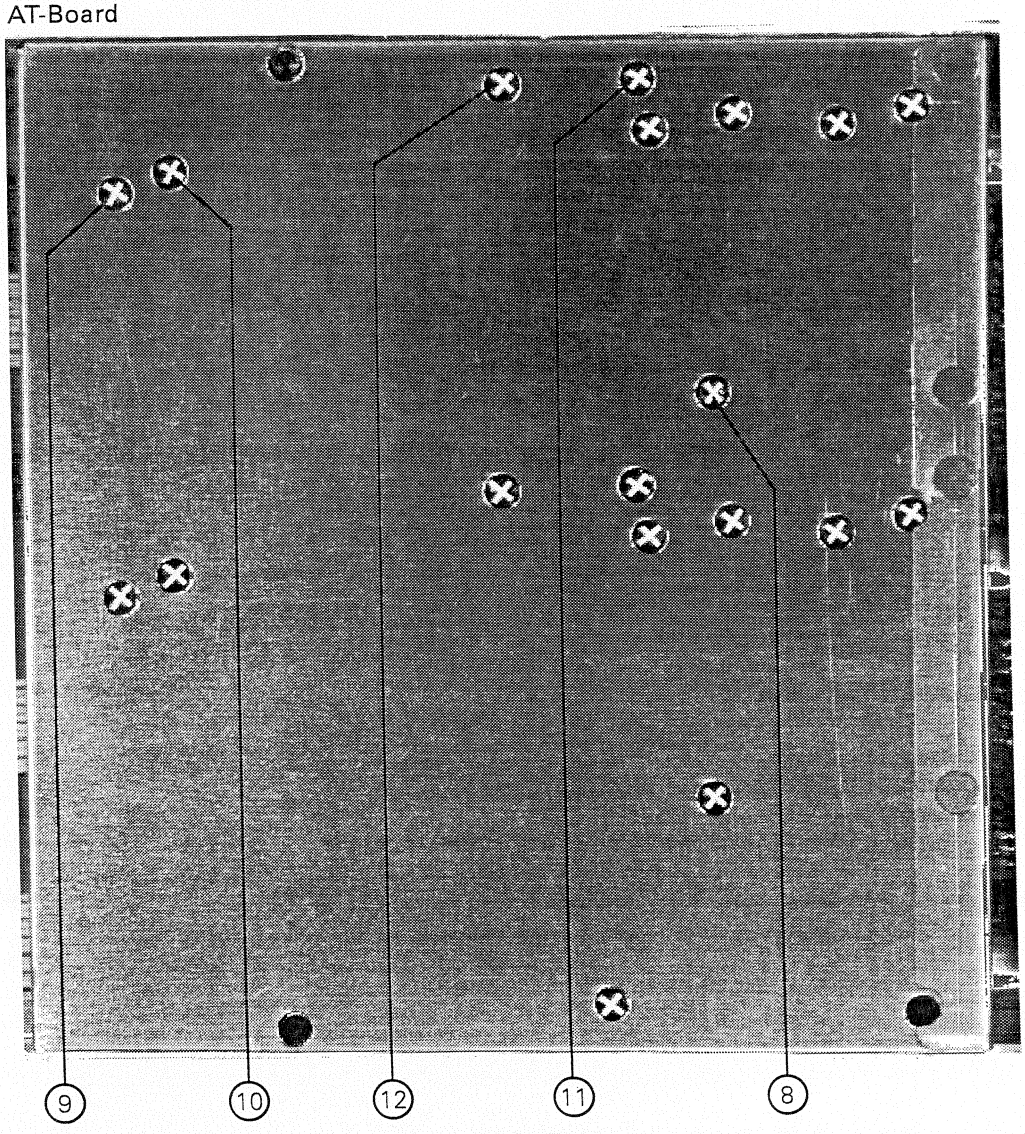
6) R6024 : Astigmatism correction.

Locate and identify R6024 (6) on CRT-Board.
Press channel I GD pushbutton (GD LED lit).
Press XY pushbutton (XY LED lit).
Adjust INTENS. (front panel) for low intensity.
Turn the FOCUS knob continuously to defocus the spot in both directions from the focus point until the next procedure is finished.
Adjust R6024 (6) so that the spot shape does not change when defocussed.

YF-Board



AT-Board



7) R9023: Y-Gain CH I.

Locate and identify R9023 (7) on YF-Board.
Connect a 25mVpp/1kHz square wave signal via 50Ω cable and 50Ω through terminator to input channel I.
Set time base to 1ms/div.
Adjust R9023 (7) for 5 division signal height.

Note: This adjustment also affects Y-Gain CH II.

8) R2189: FET operating point CH I.

Locate and identify R2189 (8) in CH I section of the AT-Board.
Press channel I GD pushbutton (GD LED lit).
Press EXT. pushbutton (EXT LED lit).
Turn Y-POS. I knob to set the trace exactly on the horizontal center line of the graticule.
Press channel I GD pushbutton (GD LED dark).
Adjust R2189 (8) for the same Y-position as before when grounded.

9) R2141: Invert-Balance CH I.

Press channel I GD pushbutton (GD LED lit).
Set input attenuator channel I to for 1mV/div.
Press EXT. pushbutton (EXT LED lit).
Locate and identify R2141 (9) on AT-Board.
Press, release and press channel I INV pushbutton continuously.
Adjust R2141 (9) so that the baseline will not move, when switching the invert function on and off.

10) R2131: Variable-Balance CH I.

Press channel I GD pushbutton (GD LED lit).
Set input attenuator channel I to 1mV/div.
Press EXT. pushbutton (EXT LED lit).
Locate and identify R2131 (10) on AT-Board.
Adjust R2131 (10) so that the baseline does not move when turning the channel I VAR. 2.5:1 knob through the entire range.

Check adjustment 9) again and repeat it if required.

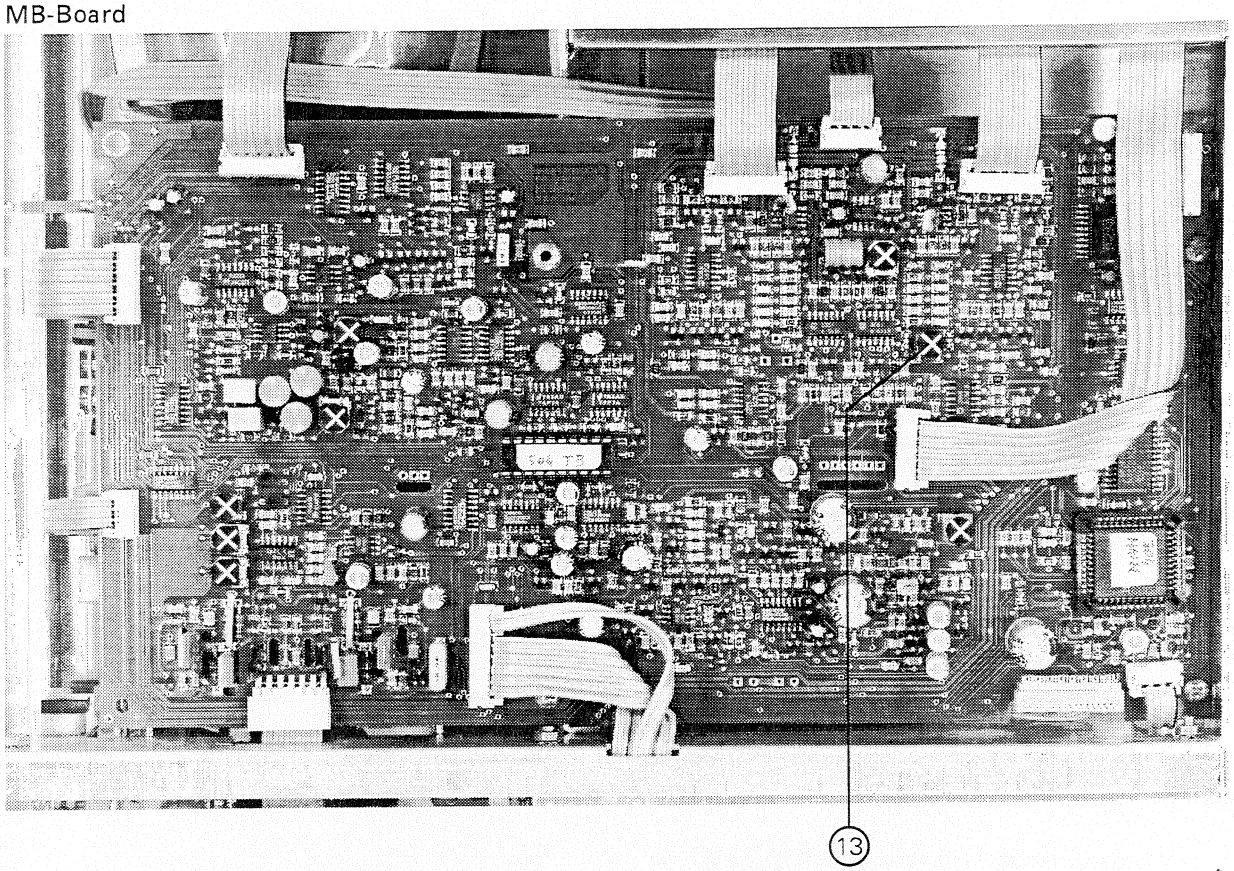
11) R2000: 10Hz Squarewave 5mV/div CH I.

Locate and identify R2000 (11) in CH I section of the AT-Board.
Connect a 25mVpp/10Hz square wave signal via 50Ω cable and 50Ω through terminator to input channel I.
Set time base to 10ms/div.
Adjust R2000 (11) for flat top.

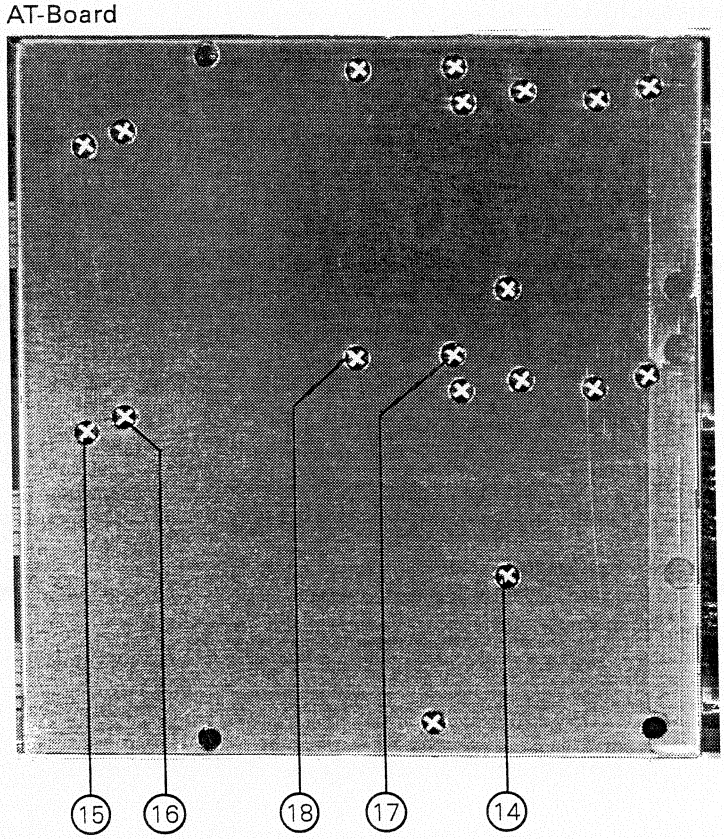
12) R2002: 10Hz Squarewave 1mV/div Adjustment CH I.

Locate and identify R2002 (12) in CH I section of the AT-Board.
Connect a 5mVpp/10Hz square wave signal via 50Ω cable and 50Ω through terminator to input channel I.
Set input attenuator channel I to 1mV/div
Set time base to 10ms/div.
Adjust R2002 (12) for flat top.

MB-Board



AT-Board



Subject to change without notice

13) R3403: Y-Gain CH II.

Note: The adjustment under item 7) must be finished before this procedure is started.
Locate and identify R3403 (13) on MB-Board.
Connect a 25mVpp/1kHz square wave signal via 50Ω cable and 50Ω through terminator to input channel II.
Set time base to 1ms/div.
Adjust R3403 (13) for 5 division signal height.

14) R2389: FET operating point CH II.

Press CH II pushbutton to switch channel II on.
Press CH I pushbutton to switch channel I off.
Locate and identify R2389 (14) in CH II section of the AT-Board.
Press channel II GD pushbutton (GD LED lit).
Press EXT. pushbutton (EXT LED lit).
Turn Y-POS. II knob to set the trace exactly on the horizontal center line of the graticule.
Press channel II GD pushbutton (GD LED dark).
Adjust R2389 (14) for the same Y-position as before when grounded.

15) R2341: Invert-Balance CH II.

Press CH II pushbutton to switch channel II on.
Press CH I pushbutton to switch channel I off.
Press channel II GD pushbutton (GD LED lit).
Set input attenuator channel I to 1mV/div.
Press EXT. pushbutton (EXT LED lit).
Locate and identify R2341 (15) on AT-Board.
Press, release and press channel II INV pushbutton continuously.
Adjust R2341 (15) so that the baseline does not move, when switching the invert function on and off.

16) R2226: Variable-Balance CH II.

Press CH II pushbutton to switch channel II on.
Press CH I pushbutton to switch channel I off.
Press channel II GD pushbutton (GD LED lit).
Set input attenuator channel II to 1mV/div.
Press EXT. pushbutton (EXT LED lit).
Locate and identify R2226 (16) on AT-Board.
Adjust R2226 (16) so that the baseline will not move when turning the channel II VAR. 2.5:1 knob through the entire range.
Check adjustment 15) again and repeat it if required.

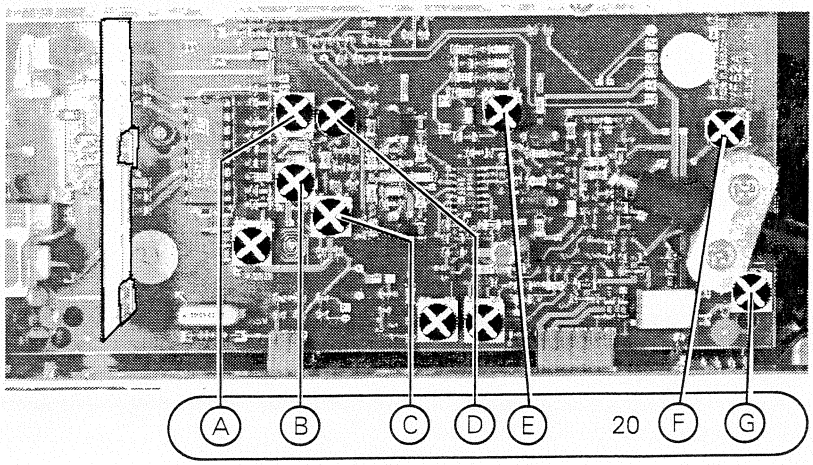
17) R2200: 10Hz Squarewave 5mV/div CH II.

Press CH II pushbutton to switch channel II on.
Press CH I pushbutton to switch channel I off.
Locate and identify R2200 (17) in CH II section of the AT-Board.
Connect a 25mVpp/10Hz square wave signal via 50Ω cable and 50Ω through terminator to input channel II.
Set time base to 10ms/div.
Adjust R2200 (17) for flat top.

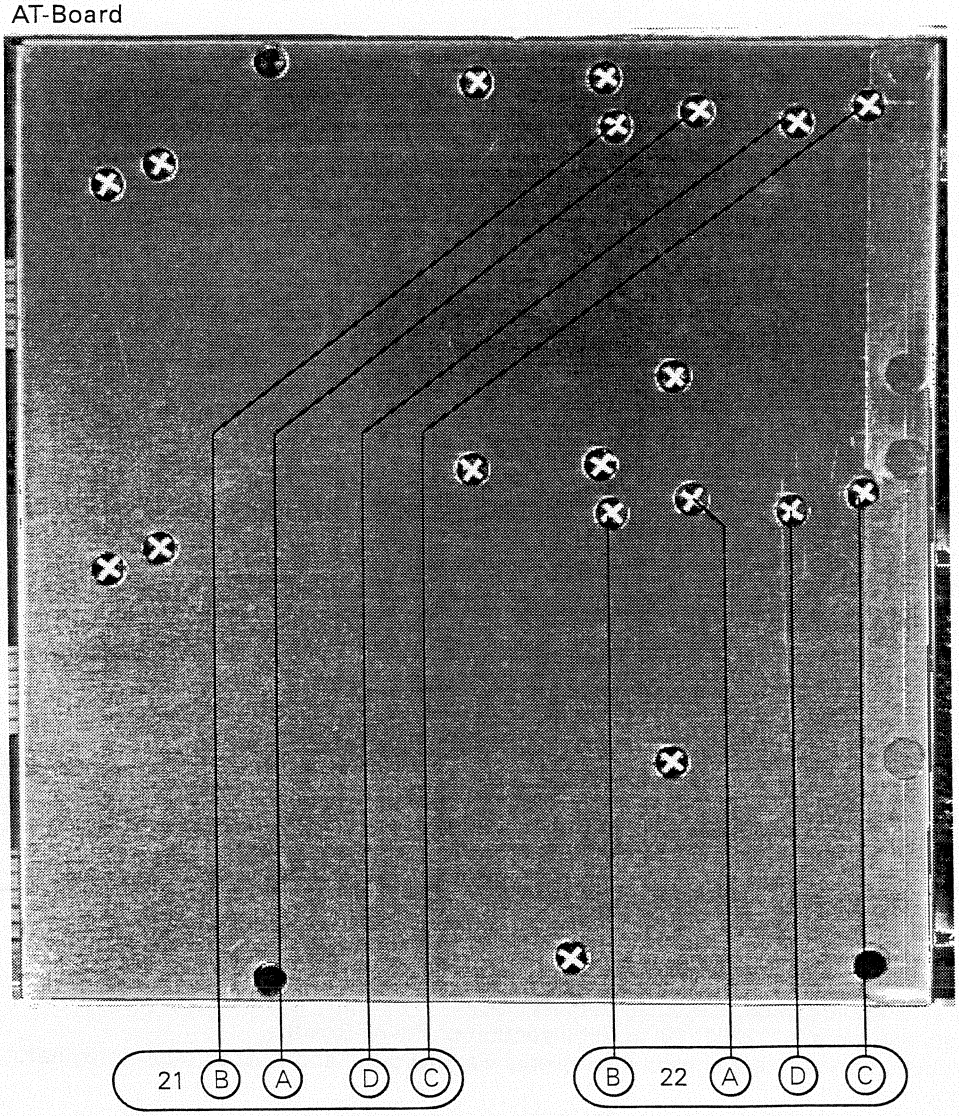
18) R2202: 10Hz Squarewave 1mV/div CH II.

Press CH II pushbutton to switch channel II on.
Press CH I pushbutton to switch channel I off.
Locate and identify R2202 (18) in CH II section of the AT-Board.
Connect a 5mVpp/10Hz square wave signal via 50Ω cable and 50Ω through terminator to input channel II.
Set input attenuator channel II to 1mV/div
Set time base to 10ms/div.
Adjust R2202 (18) for flat top.

YF-Board



AT-Board



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19) R9063 (A), C9025 (B), R9075 (C), C9008 (D), R9100 (E), R9103 (F) and C9022 (G): Y-Final Amplifier.

Connect a 1MHz square wave signal of 25mVpp via 50Ω cable and 50Ω throughtermination to input CH I.
Set time base to 0.05µs/div. for overshoot and 0.2µs/div. for adjustments of the top.
Locate and identify the adjustment points R9063 (A), C9025 (B), R9075 (C), C9008 (D), R9100 (E),R9103 (F) and C9022 (G) on YF-Board.
Adjust all adjustment points for flat top, fast leading edge (minimum risetime) and minimum overshoot.

Please note: The adjustment points A, F and G are most important for the overshoot and bandwidth. B, C, D and E influence the top.
Repeat the adjustment of each adjustment point until optimum is obtained.
Check channel II under the same conditions.

20) Y-Amplifier Bandwidth Check.

Connect a 40mVpp/50kHz sinewave signal from a constant amplitude generator via a 50Ω throughtermination to the input of channel I.
Adjust the generator amplitude for 8 div. display height on the screen.
Increase the generator frequency until the signal height is 5.6 div. (-3dB).
Repeat the adjustment under item 19), if the frequency reading on the generator shows a value less than 60 MHz.
Repeat the same procedure under channel II operating conditions.

21) C2009/2013/2007/2012: Attenuator Compensation CH I.

Locate and identify trimmers C2007, 2012, 2009 and 2013 in CH I section of the AT-Board.
Set time base switch to 0.2ms/div.
Set amplitude calibrator to 1kHz, connect a 50Ω cable at the generator output and via a 2:1 pre-attenuator to input of CH I.
Set calibrator output voltage to 80mVpp (40mVpp at the 2:1 preattenuator output).
Check for 8 divisions signal height (5mV/div. attenuator setting).
Adjust trimmer in pre-attenuator for flat square wave top. This adjustment must not be changed during the following procedure.
Adjust compensation as listed in the table below:

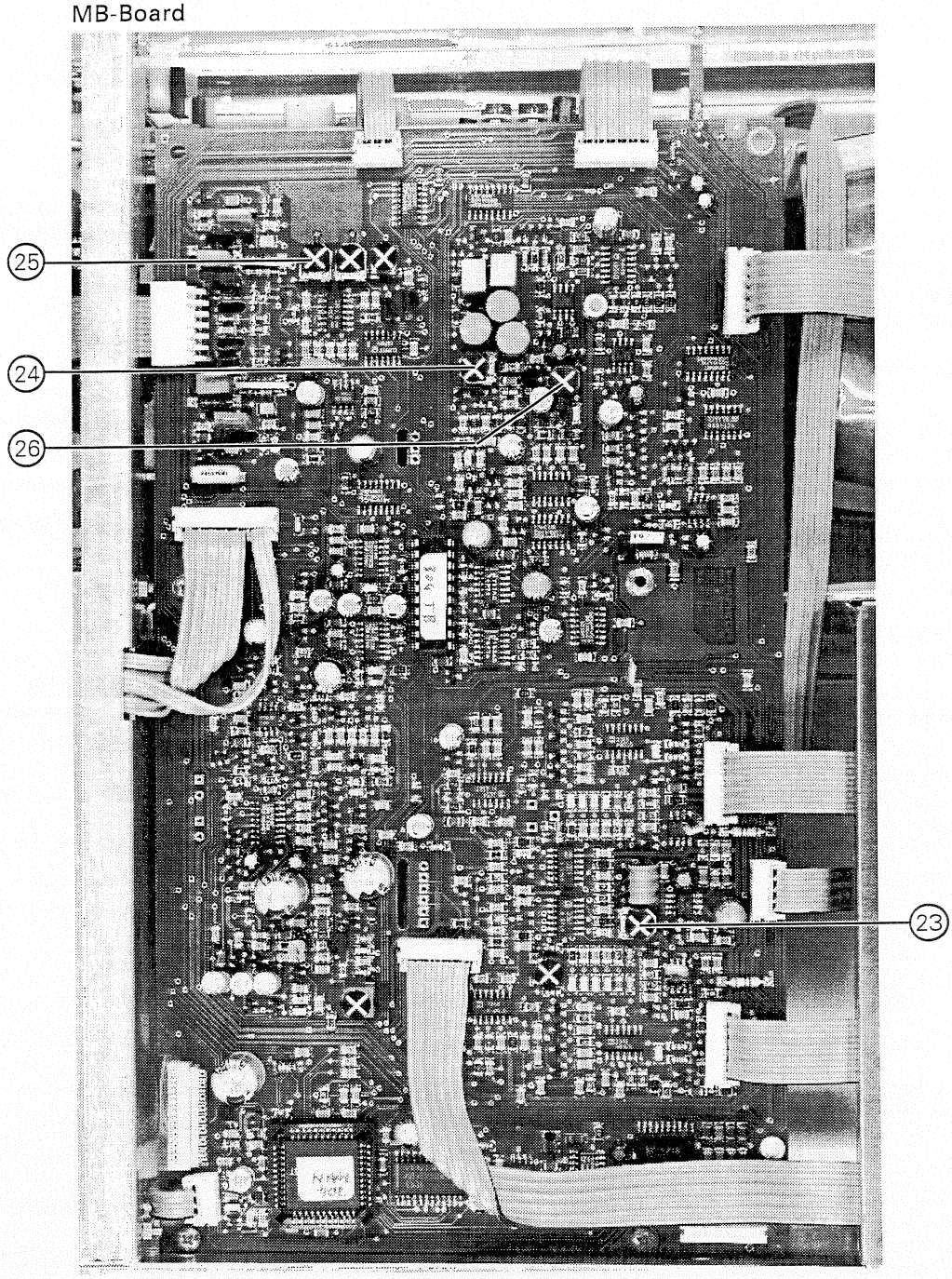
Scope Input	Input Atten.	Adjustment CH I
250mVpp	50mV/div	21A (C2009) flat top 21B (C2013) leading edge
2.5Vpp	0.5V/div	21C (C2007) flat top

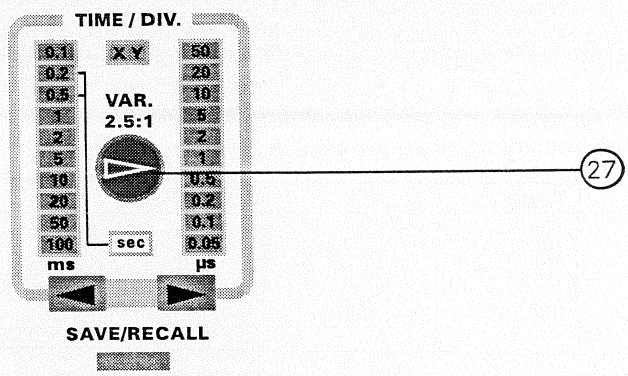
22) C2209/2213/2207/2212: Attenuator Compensation CH II.

Press CH II pushbutton to switch channel II on.
Press CH I pushbutton to switch channel I off.
Locate and identify trimmers C2207, 2212, 2209 and 2213 in CH II section of the AT-Board.
Set time base switch to 0.2ms/div.
Set amplitude calibrator to 1kHz, connect a 50Ω cable to the generator output and, via a 2:1 preattenuator to input of CH I.
Set calibrator output voltage to 80mVpp (40mVpp at the 2:1 preattenuator output).
Check for 8 divisions signal height (5mV/div. attenuator setting).
Adjust trimmer in pre-attenuator for flat square wave top. This adjustment must not be changed during the following procedure.
Adjust compensation as listed in the table below:

Scope Input	Input Atten.	Adjustment CH II
250mVpp	50mV/div	22A (C2209) flat top 22B (C2213) leading edge
2.5Vpp	0.5V/div	22C (C2207) flat top 22D (C2212) leading edge

MB-Board





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23) R3613: ADDition/Offset.

Press CH II pushbutton to switch channel II on.
Check that the oscilloscope is operated in DUAL mode.
Locate and identify R3613 (23) on MB-Board.
Press channel I GD pushbutton (GD LED lit).
Press channel II GD pushbutton (GD LED lit).
Move both baselines with Y-POS. I and II knobs to the horizontal center line of the graticule.
Press CH I and CH II pushbuttons simultaneously (ADD LED lit).
Adjust R3613 (23) for the same signal position as before in DUAL mode.

24) R4430: Sweep Start Position.

Locate and identify R4430 (24) on MB-Board.
Set time base to 0.1ms/div.
Turn X-POS. knob to the right stop (cw).
Adjust R4430 (24) for a trace start at the CRT center.
Check the maximum trace start position for a deviation of not more then 1 division, in the time base ranges from 0.1ms/div up to 0.1µs/div.

25) R4841: X-Gain x1.

Locate and identify R4841 (25) on MB-Board.
Adjust R4841 (25) for 10.2 div sweep length.

26) C4411: Sawtooth Start Linearity.

Turn X-POS. knob to the right stop (cw).
Connect a 40mVpp/1MHz triangle signal to input of channel I.
Set time base to 2µs/div.
Press X-MAG. x10 pushbutton (x10 LED lit).
Locate and identify C4411 (26) on MB-Board.
Adjust C4411 (26) for a linear slope at the trace start.

27) Time Base Adjustment.

Note: The oscilloscope must first be switched to the adjustment mode.

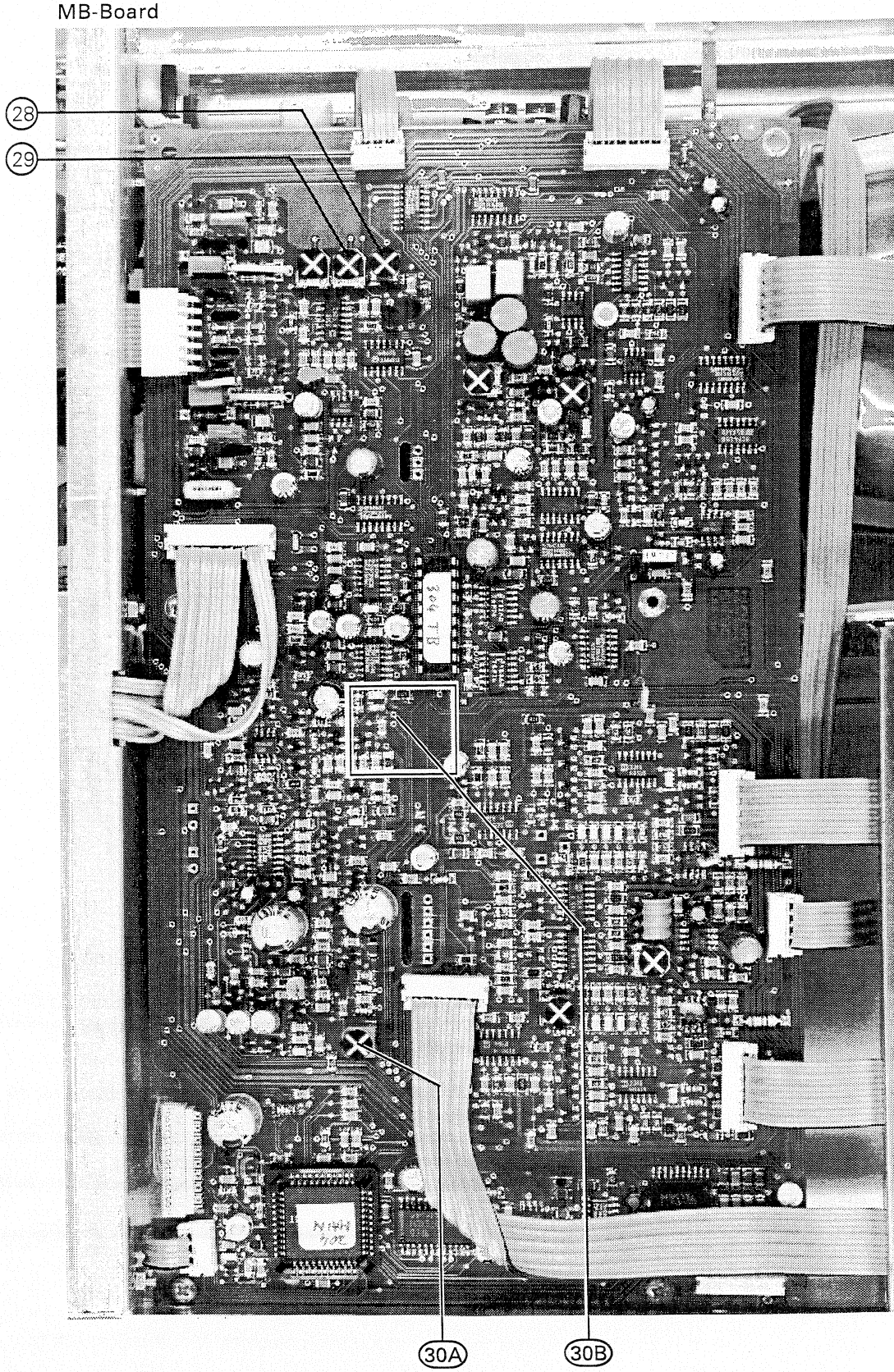
Switch the oscilloscope OFF.
Press and hold the AUTO SET pushbutton.
Switch the oscilloscope ON.
Release the AUTO SET pushbutton after approx. 2 seconds (no further LED activities).

Note: Now the adjustment mode is present. Any change of the VAR. 2.5:1 knob in the TIME/DIV. section of the front panel causes a new adjustment of the selected time coefficient. After the TIME/DIV. setting was changed, the adjustment is stored.

Remark: The horizontal center line of the graticule must be used for the reading to avoid uncertainties due to deflection unlinearities.
The manual contains a list of frequencies which must be used for the different time base settings if a sine wave generator is used for adjustment purposes.
For a high accuracy use the zero (voltage) crossing of a sine wave signal for the reading.

Set time mark generator to 20MHz (0.05µs/period) and connect the signal to CH I input.
Set input attenuator CH I to a suitable setting for a signal display of approx. 4 divisions height.
Press both NORM pushbuttons briefly for normal triggering mode (NM LED lit).
Turn TRIG. LEVEL knob for exact triggering.
Set time base to 0.05µs/div.
Move trace with X-Pos. control so that the first time mark coincides with the first left graticule line of the screen.
Rotate VAR. 2.5:1 (TIME/DIV) (28) until the 11th time mark coincides with the last right graticule line. If only 10 time marks are visible, set the 10th time mark on the last but one (next to the last) right graticule line.

MB-Board



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Save the time base adjustment by switching over to the next TIME/DIV. setting (0.1µs/div.).
Set time mark generator to 10MHz (0.1µs/div).
Rotate VAR. 2.5:1 (TIME/DIV) (28) until the 11th time mark coincides with the last right graticule line. If only 10 time marks are visible, set the 10th time mark on the last but one (next to the last) right graticule line.
Save the time base adjustment by switching over to another TIME/DIV. setting (0.2µs/div.).
Operate for each time base setting in the same way.
After the last adjustment was made (e.g. 0.5s/div), the last VAR. 2.5:1 setting must not be changed.
Switch the time base from 0.5s/div. back to 0.2s/div.and do not change the VAR. 2.5:1 knob.
Switch the oscilloscope OFF to leave the adjustment mode.
Now all time base adjustments are stored.

Switch the oscilloscope ON.
Set time mark generator to 20MHz (0.05µs/period) and connect the signal to CH I input.
Set input attenuator CH I to a suitable setting for a signal display of approx. 4 divisions height.
Press both NORM pushbuttons briefly for normal triggering mode (NM LED lit).
Turn TRIG. LEVEL knob for exact triggering.
Set time base to 0.05µs/div.
Move trace with X-Pos. control so that the first time mark coincides with the first left graticule line of the screen.
Rotate time base variable control to fully left position.
Now more than 2.5 time marks per division must be displayed.
Check all TIME/DIV. settings with suitable signals in the same way.

28) R4840: X-Magnification x10.

Locate and identify R4840 (28) on MB-Board.
Press pushbutton X-Mag. x10 (x10 LED lit).
Set time base to 1µs/div.
Set time mark generator to 10MHz and connect signal to channel I input.
Set input attenuator CH I to a suitable setting for a signal display of approx. 4 divisions height.
Set X-POS control to mechanical center.
Using X-POS control, move the first visible time mark to the first left graticule line.
Adjust R4840 (28) so that the next time mark coincides with the last (right) graticule line.

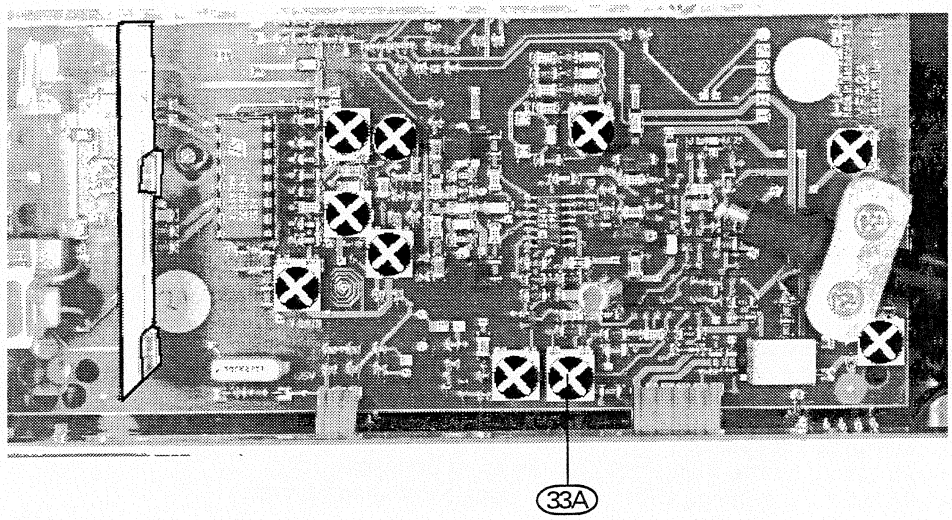
29) R4839: XY-Gain

Press CH II pushbutton to switch channel II on.
Press CH I pushbutton to switch channel I off.
Locate and identify R4839 (29) on MB-Board.
Connect a 10kHz square wave signal of 25mVpp amplitude (HZ60-2) to input CH II.
Press XY pushbutton (XY LED lit).
Set X-POS control that the left dot coincides with the graticule center.
Adjust R624 (29) for a distance of 5 division between left and right dot.

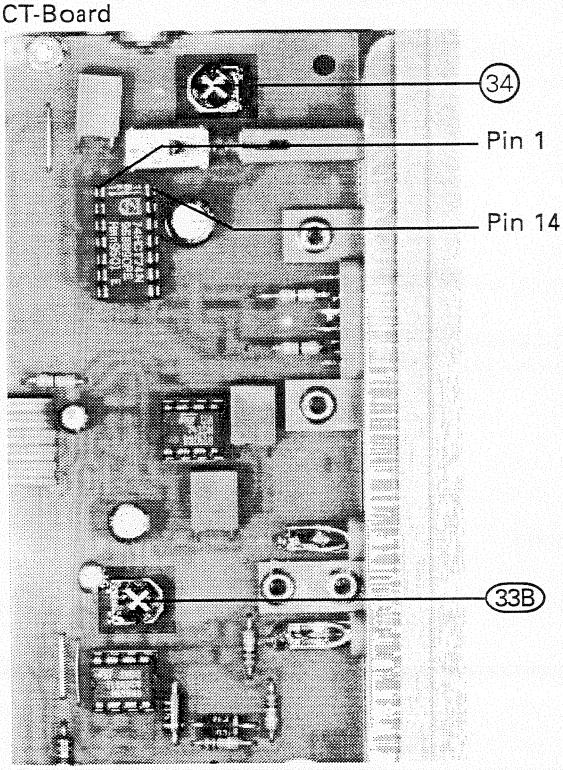
30) R5028: Trigger Operating Point.

Locate and identify R5028 (30A) on MB-Board.
Locate and identify MP1 (30B) on MB-Board.
Measure the DC voltage at 30B with respect to ground.
Adjust R5028 (30A) for +2.5Volt (± 10mV).

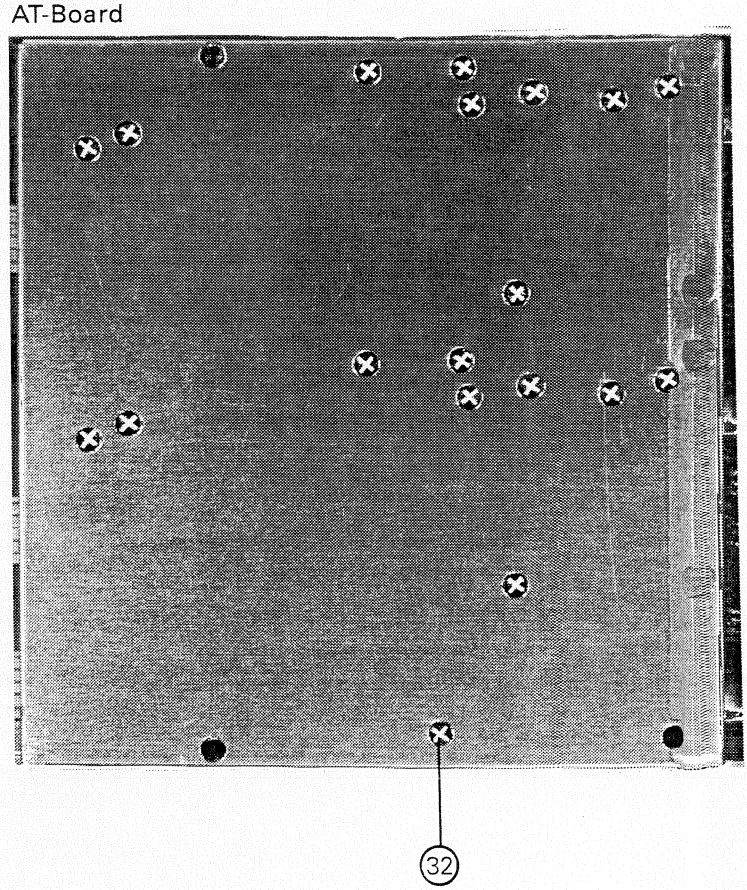
YF-Board



CT-Board



AT-Board



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31) Peak to Peak Trigger Operating Point.

Note: The oscilloscope must first be switched to the adjustment mode.

Switch the oscilloscope OFF.
Press and hold the AUTO SET pushbutton.
Switch the oscilloscope ON.
Release the AUTO SET pushbutton after approx. 2 seconds (no further LED activities).

Press both NORM trigger pushbuttons in simultaneously.
Release both NORM trigger pushbuttons after the TRIG. LED has started blinking.
After the TRIG. LED has stopped blinking, the adjustment is finished.
Switch the oscilloscope OFF to leave the adjustment mode.

32) R2433: External Trigger Operating Point.

Press EXT pushbutton (EXT LED lit).
Locate and identify R2433 (32) on AT-Board.
Locate and identify MP1 (30B) on AT-Board.
Measure the DC voltage at MP1 (30B) with respect to ground.
Adjust R2433 (32) for +2.5Volt (± 10mV).

33) R9004 (A), VR4322 (B): Component Tester Y-Position and Tilt.

Press COMP. TESTER pushbutton.
Now if the COMP. TESTER input sockets are not connected, a trace of approx. 7 - 8 division length must be visible.
Locate and identify R9004 (33A) on YF-Board.
Adjust R9004 (33A) to shift the horizontal component tester trace to the horizontal center of the CRT graticule.
Locate and identify VR4322 (33B) on CC-Board.
Set up the instrument on a table in normal operating conditions to avoid misadjustment due to the influence of the earth magnetic field.
Adjust VR4322 (33B) in such a way that the trace is parallel to the horizontal graticule centerline and not tilted.

34) VR8940: Calibrator Output.

Locate and identify VR8940 (36) on CT-Board.
Connect a digital multimeter to the 0.2Vpp calibrator output.
Set up the digital multimeter for DC measurement on a suitable sensitivity setting.
Locate and identify IC8903 on CT-Board.
Connect pin 1 and pin 14 of IC8903 galvanically together.
Adjust VR8940 (34) for exactly 200mV ± 1mV DC.
Check 2V calibrator output.
Remove the connection between pin 1 and pin 14 of IC8903.

Connect a 10:1 probe to the 0.2Vpp calibrator output and connect it to the CH I input of the scope.
Set time base to 0.2ms/div.
Now approximately 2 signal periods should be visible on the screen.
Press 1kHz/1MHz pushbutton (in!).
Set time base to 0.5µs position.
Check 1MHz calbrator signal.

Please note: Neither the calibrator frequency nor the pulse duty factor are specified.

35) Trigger Filter Check.

Set time base to 1ms/div.
Connect a 1kHz sinewave signal of 25mVpp amplitude to input CH I and check for full screen deflection.
Set input attenuator CH I to 50mV/div and check for 5mm display height.
Select trigger coupling AC, DC, HF and LF.
Except in HF trigger coupling condition, the signal must always trigger the oscilloscope.
Set time base to 20µs/div.

Set sinewave generator to 50kHz and 25mV output amplitude and check for 5mm display height.
Select trigger coupling from AC, DC, HF and LF.
Except in LF trigger coupling condition, the signal must always trigger the oscilloscope.

36) Triggerbandwidth Check.

Set time base to 0.05µs/div.
Connect a 100MHz sinewave signal to input CH I.
Adjust generator output for 5mm display height.
The signal must be triggered.

37) External Trigger Check.

Set time base to 20µs/div.
Set input attenuator CH I to 0.1V/div.
Connect a 50kHz sinewave signal via a 50Ω through terminator with an amplitude of 280mVpp (100mVrms) to input CH I and check for 2.8div display height.
Set TRIG. LEVEL to midrange position.
Check that the Trigger-LED is lit.
Press EXT. pushbutton (EXT LED lit).
The TRIG. LED now must be dark.
Press GD pushbutton channel I (GD LED lit).
Remove signal cable from input CH I and connect it to the TRIG.INP. socket.
Now the TRIG. LED must lit.

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